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A HISTOLOGIC STUDY OF THE THYROID OF EXOPHTHALMIC GOITER AT INTERVALS DURING THE ADMINISTRATION OF IODINE

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THIS study is based upon the pathologic observations on thyroid tissue removed at operation from 110 patients suffering from exophthalmic goiter who were treated at the Mayo Clinic. These patients had been treated by stage lobectomy, the interval between stages varying from twelve to three hundred days. Of these patients 100 had been given compound solution of iodine (Lugol's solution) previous to the first stage and during the interval between stages. In ten cases, used as controls, iodine had not been given either previous to the first stage or in the interval between operations.

Separate sections were made for each stage, the identity and date being placed on the label which was then covered so that only the identity was visible. Upon microscopic study the sections were designated as A and B with no knowledge as to which stage was represented. Microscopic observations in the entire series were recorded before this was known and without knowledge of the clinical data. By this method all possible bias was eliminated.

Sections of tissue were selected for microscopic study from the center of each lobe because Giordano and Caylor have shown that ligation of the thyroid vessels causes changes in the poles of the gland somewhat comparable to those produced by the administration of iodine.

The sections were studied microscopically as regards the accepted criteria[2, 3, 14, 15] of the constituents of the hypertrophic parenchymatous thyroid. These changes are well known but will be briefly described here. The normal cuboidal lining epithelium becomes columnar. The

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acinar lining, smooth in the normal thyroid, becomes broken by the appearance of papillary infoldings, dependent in their formation upon the hypertrophy of the lining cells. Colloid becomes reduced in quantity and is thin and fragmented in appearance. In addition to these Warthin described a fourth change, the collection of lymphocytes within the gland. Upon administration of Lugol's solution, as was shown by Reinhoff, the above abnormal characteristics tend to approach normal.

In this study the terms increased and decreased activity have been chosen to apply to the changes in the histologic picture undergone when the hypertrophic or involutional phenomena take place. It would seem that these changes could be thought of as evidence of increased activity within the gland as opposed to evidence of decreased activity referring to involution. It is true that these changes occur in experimental animals[10] upon removal of a portion of the normal gland, but here again this seems to indicate increased activity in the remaining portion. The use of this term precludes the use of such expressions as "increased parenchymatous hypertrophy" while it designates this change. The amount and quality of colloid present were considered only secondarily because of the technical difficulty of retaining all the colloid through the processes of cutting and staining.

Regenerative hyperplasia,[1] thyroiditis, fibrosis, and vascularity were also noted as was the presence or absence of germ centers. These characteristics were graded individually on the basis of one to four, the sections of the two stages from each patient being compared directly. Thus, if the material from the first stage should show higher epithelium, more papillary infoldings, and less colloid than that of the second stage, the first is considered "more active" than the second and vice versa.

The material was compared in this manner as regards the total days of administration of iodine, the number of days of iodine between the two stages, the seasonal variation, and in association with the basal metabolic rate of the patient. The findings were graphed in the following manner: each gland which showed evidence of increased activity in the second stage was graded as +1; each gland in which a decreased activity was noted in the second stage was graded as –1; and those where no demonstrable change was found were graded as 0. The "activity gradings" are the average of the sum of each column in the various tables.

In the material used previous operations had been performed as follows: ligation of vessels, 17; hot water injections, 14; thyroidectomy, 10; ligation and hot water injections, 8; and none, 51. In the control series 7 cases had had previous vessel ligation, 1 had had both vessel ligation and hot water injection, and in 2 cases no operation had been done.

RESULTS

Hertzler studied material from stage thyroidectomies and stated that in the second stage the material is similar to that removed at the first operation as regards its cellular structure. He felt that the changes present were found in the colloid, which he found to stain more deeply and to fill out the acini more completely. Cattell[4] also studied the material from forty-one patients on whom stage thyroidectomies were done. Of these, thirteen had had compound solution of iodine before both stages. In nine cases of this group a decrease in activity, or involution, was noted; one case showed an increase in activity and in three cases there was no demonstrable change in the histologic picture.

In the series reported here of 100 cases in which the patients were treated with Lugol's solution, no change in activity was noted in 57 cases; in 25 cases there was an increase in activity in the second stage over the first, and in the remaining 18 cases a decrease in the histologic evidence of activity was noted. In the "no change" group the average interval between stages was 93 days; the average number of days of administration of compound solution of iodine, 139.1. In those cases in which an increase in activity was noted in the second stage, the average interval between stages was 90.5 days; the average number of days of administration of iodine, 147.4. In those showing a decrease in activity in the second stage the average interval was 108.6 days; the average number of days of administration of iodine was 163.3. In the controls no change was noted in 3 cases, an increase in activity in 2 cases, and a decrease in 5 cases.

Table I relates the change in activity of the material from the two stages to the total days of iodine administration. The majority of cases in which activity was increased in the second stage over that of the first fall within the shorter intervals of iodine administration, while in those in which a decreased activity was noted in the second stage the interval of iodine administration is longer as an average.

TABLE I

RELATION OF CHANGE IN ACTIVITY TO TOTAL DAYS OF IODINE ADMINISTRATION

	TOTAL DAYS OF IODINE ADMINISTRATION						
	0-49	50-99	100-174	175-249	250-324	325-399	400+
Increased activity	4	4	10	5	2	0	0
Same activity	4	19	22	5	4	2	1
Decreased activity	2	2	6	5	2	0	1
Activity grading	+0.20	+0.08	+0.10	0	0	0	-0.50

Table II, giving a similar comparison of change in activity with the days of administration of iodine between stages, shows a similar trend. In other words, it seems that in this series in cases in which a change was noted more cases showed histologic evidence of decreased activity in the second stage when the interval of iodine administration was prolonged than when it was short.

TABLE II

RELATION OF CHANGE IN ACTIVITY TO DAYS OF IODINE BETWEEN STAGES OF LOBECTOMY

	DAYS OF IODINE				
	0-49	50-99	100-149	150-199	200-249
Increased activity	7	8	9	0	1
Same activity	18	22	9	4	4
Decreased activity	4	6	4	2	2
Activity grading	+0.10	+0.05	+0.22	-0.33	-0.14

Upon comparing the grade of activity of the second stage on the basis of one to four without regard for the first stage Fig. 1 was obtained. No definite tendency to increased activity was noted after prolonged intervals of iodine administration. A study of the "activity grading" based upon the number of months of the disease gave no significant findings and is not included here.

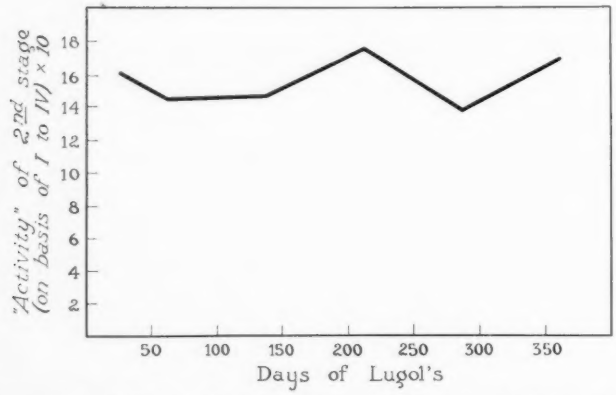

Fig. 1.—Average activity of thyroid tissue at the second stage of lobectomy in relation to the length of time during which the patient had received Lugol's solution.

Consideration of basal metabolic rates shows an average drop in the basal rate of 11.1 degrees in the group in which no change was noted; a drop of 15.1 degrees in the group showing an increased activity in the second stage; a drop of 17.7 degrees in the "decrease" group. Those were the final basal rates taken before each stage.

In 27 cases basal metabolic rates were taken soon after the first stage was done. These were compared with the basal metabolic rates before the second stage after an interval of administration of compound solution of iodine averaging 181.1 days. The average basal rate after the first stage was +34.7 per cent and that before the second stage was +33.3 per cent, a drop of 1.4 per cent or practically no change. The average interval between the stages in this small group was 115.8 days. Obviously an identical amount of thyroid tissue was present in the patient for both of these readings. Fig. 2 was obtained

by comparing the average change in basal metabolic rate in this small group to the number of days elapsing between the readings. It will be noted that the greatest average change in basal metabolic rate was obtained in the group in which the smallest number of days elapsed between readings and also the smallest number of days of iodine administration.

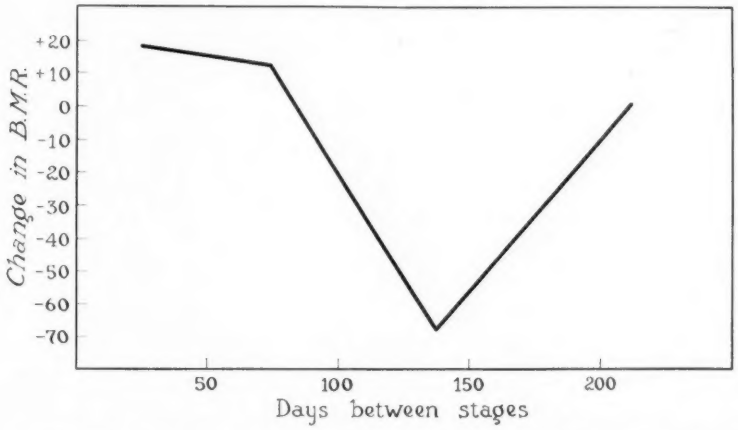

Fig. 2.—Average change in basal metabolic rate from soon after the first stage of thyroid lobectomy to before the second stage, in relation to length of time between stages.

Table III is based upon the ratio of the basal metabolic rate before each operation to the weight of removable gland in grams. Thus, in the first stage the basal metabolic rate is divided by the total weight of gland removed in both stages and in the second stage by the weight removed at that operation. It would seem that a high ratio might be interpreted as meaning more intense glandular activity. A greater decrease in the ratio of the second stage from that of the first stage might indicate a greater decrease in "activity" of the gland. As is shown in Table III, the decrease in the ratio was greater in the group classified on a histologic basis as showing a decrease in activity than in the group showing no histologic change and still greater than in the group showing histologic evidence of increased activity. These findings may help to confirm the criteria and method used in this study. By these criteria there is no evidence to indicate an increase

TABLE III

RATIO OF BASAL METABOLIC RATE BEFORE EACH STAGE OF LOBECTOMY TO WEIGHT OF REMOVABLE GLAND IN GRAMS IN RELATION TO THE CLASSIFICATION OF CHANGE OF ACTIVITY OF THE THYROID ON A HISTOLOGIC BASIS

	RATIO 1ST STAGE	RATIO 2ND STAGE	DECREASE
Increase group	2.73	1.97	0.76
No change group	2.98	1.69	1.29
Decrease group	3.16	1.58	1.58

in thyroid activity after varying periods of medication with Lugol's solutions. The average weight of gland removed in the first stage was 77.5 gm.; in the second stage, 64.1 gm.

Interesting data were obtained upon studying the material as regards the season in which the second stage was done. These are shown in Table IV. There seems to be a tendency to increase in activity of the gland during cooler weather. This finds some confirmation in the work of Curtis, Kendall, and Cattell,[3] who found the iodine content of the human thyroid to be highest in the summer and lowest in the winter. The iodine content of the gland has been shown to vary directly as the amount of colloid present or inversely as the amount of "activity" present.[11] Also Loeb found the average hypertrophy to be less marked in the summer months than in experiments carried out during the winter on guinea-pigs upon which previous partial thyroidectomy had been done. These findings were graphed to show the relation of the activity of the gland to the month of the second stage by the method used previously (Table V). Accompanying this table are the average days of iodine medication and the average months of duration of the disease for each period. As will be seen, these factors are eliminated as having bearing on the findings in Table V. Except for a discrepancy in the month of August, there seems to be shown by this method, also, an increased activity in the cooler months.

TABLE IV

RELATION OF CHANGE IN ACTIVITY TO SEASON OF SECOND STAGE OF LOBECTOMY

	2ND STAGE IN COOLER SEASON	2ND STAGE IN HOTTER SEASON	BOTH STAGES SAME SEASON
Increased activity	13	8	4
Same activity	23	23	11
Decreased activity	6	11	1
Controls:			
Increased activity	1	1	0
Same activity	0	1	2
Decreased activity	1	3	1

With regard to regenerative hyperplasia, we did not know when the study was begun whether this could be taken as a criterion of activity. Consequently, this was considered independently. It was found, however, that the amount of regenerative hyperplasia present varied in direct proportion to the increase or decrease in activity noted in all but six cases. Conversely, colloid when judged by amount and quality present, varied inversely as did the activity in all except nine cases. As was stated previously, colloid was not used as a criterion of activity because of possible loss in cutting and staining.

In a comparative study of thyroiditis, germinal centers were found in 15 cases. An increase in thyroiditis in the second stage over the first stage was found in 29 cases In 66 cases there was no change

TABLE V

RELATION OF CHANGE IN ACTIVITY TO MONTH OF SECOND STAGE OF LOBECTOMY

	MONTH OF SECOND STAGE OF OPERATION											
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Increased activity	2	2	3	2	2	0	0	5	0	2	4	3
Same activity	7	2	7	2	5	8	2	5	4	3	4	8
Decreased activity	2	0	2	2	1	2	3	2	1	1	2	0
Activity grade	0	+0.50	+0.08	0	+0.12	−0.20	−0.60	+0.25	−0.20	+0.16	+0.20	+0.27
Average days iodine between stages	89.8	69.7	86.0	69.8	114.8	109.7	84.0	58.6	83.8	107.8	88.2	67.3
Average months disease	22.2	62.2	28.9	31.3	31.0	29.0	59.4	40.6	7.4	48.8	20.3	22.1

noted, and in 5 cases an apparent decrease was seen. The average number of days between stages and days of iodine medication were of no significance. In the controls no germ centers were found; and increased thyroiditis was noted in 3 cases, a decrease in 3 cases, and no change in 4 cases. No significant findings were made with regard to fibrosis.

COMMENT

There is considerable discussion in the literature as regards the duration of the effectiveness of iodine in the control of exophthalmic goiter. In general it is accepted that after a period of ten to fourteen days of so-called iodine remission there is an exacerbation of symptoms. Cattell,[4] however, has shown that the maximal iodine effect on the iodine content of the thyroid gland rarely occurs in less than one month and often not until after two months have passed. Plummer and Boothby also stated that maximal improvement usually occurs after iodine has been administered from eight to ten days but may be delayed two or even three weeks. Plummer[12] expressed the opinion that the response of patients with exopthalmic goiter to prolonged iodine medication appears to be determined more by what is happening to the disease spontaneously than by the iodine itself. He stated that he found no evidence that the effects of iodine were temporary. In the formulation of his two-product hypothesis of secretion of the thyroid gland he stated that iodine controls the "abnormal product" but does not control the complex caused by an excess of thyroxin. Thus, the alternation of exacerbations and remissions characteristic of the disease continues but on a smaller scale and with more marked remissions than would be seen without the control offered by iodine.

The observations in this study add nothing to settle the debate as to the time of maximal iodine control but seem to suggest that the histologic picture of exophthalmic goiter does not show evidence of increased activity after prolonged iodine administration in all cases. However, in the material where iodine was administered for shorter intervals of time (up to 150 to 200 days), it seems that there is histologic evidence of increased activity in the gland removed at the second stage operation over that removed at the first in the majority of cases studied here, where a definite change was noted.

SUMMARY AND CONCLUSIONS

One hundred cases in which exophthalmic goiter was treated by iodine and operated upon in stages have been studied histologically with a control group of ten cases in which Lugol's solution was not given. The following conclusions were drawn:

1. It seems that in this series there is evidence of a tendency toward decreased activity or histologic involution in the thyroid glands of

the majority of patients treated for long intervals by iodine in which a change was noted while there is some histologic evidence of increased activity in the second stage in the glands of most of those treated for shorter periods where a change was seen.

2. There seems to be histologic evidence of an increase in activity of the thyroid gland in exophthalmic goiter during the winter months.

3. The amount of colloid varies inversely as does the "activity" of the thyroid gland.

4. The amount of regenerative hyperplasia in the gland varies directly as does the "activity" of the thyroid gland.

5. That the histologic observations made in this study are valid is suggested by the computation and co-ordination of the ratio of basal metabolic rate to weight of thyroid substance removed.

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PROGRESSIVE POSTOPERATIVE GANGRENE OF THE ABDOMINAL WALL

With a Case Report

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PROGRESSIVE postoperative gangrene of the abdominal wall is a pathologic entity originally described by Cullen, and more recently in fuller detail by Meleney, in a number of reports. So few have been reported that it seems worth while to call it again to the attention of the profession. In fact, this condition is so rare that it is usually not observed more than once or twice in the experience of the average surgeon; but, when it does occur, it is so devastating to the patient and distressing to the surgeon that one is impressed with the importance of its early diagnosis and proper treatment.

One of the most remarkable cases, recently reported by Stewart-Wallace in the *British Journal of Surgery*, occurred in the London Hospital in 1935; following a thoracotomy and drainage of an empyema, a slowly progressive gangrenous infection of the skin and subcutaneous tissues developed. This gradually spread in spite of all therapeutic measures until after eight months it stretched from the occiput to the iliac crest behind, extended anteriorly to involve the whole abdominal surface, and finally caused the death of the patient. Several surgeons, physicians, and others at the London Hospital saw the case, but none of them could remember having met this remarkable condition before. Stewart-Wallace states that only two such cases have been described in English journals. One or more cases have also been reported in Japan, Sweden, Germany, Italy, and Australia. A review of the literature today reveals fewer than forty authenticated case reports of this condition, most of them from this country. It usually develops in an operative wound following the drainage of a peritoneal abscess, a lung abscess, or a putrid empyema. It usually begins during the second postoperative week as a painful area around a retention suture. It is often described as having a carbuncular appearance with pain, redness and swelling, and early necrosis of the skin. The surgeon may remove the offending suture at this stage, but the infection does not subside. He may then attempt an incision or a conservative excision of the gangrenous tissue, but this does not bring the infection under control. The deep drainage tract may heal, but the superficial lesion continues to advance; an ulcer forms in the center and around it the circle of gangrenous skin gradually enlarges, the central margin melts away, and the periphery gradually becomes more sharply outlined. The gangrenous margin takes on the appearance of grayish or brown-

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ish suede leather with a crenated outer margin around which there is a raised purplish zone about 0.5 to 1 cm. in width. This stands up above the level of the surrounding skin which is the seat of a brilliant erythema for a distance of several centimeters outside of the raised purple zone. Hyperpyrexia is not commonly observed, but the lesion is intensely painful and tender. The severity of this symptom, coupled with the usual inability of the surgeon to stop the infection, results in marked character changes. Individuals whose personalities have always been jovial and happy become very morose, uncooperative, and depressed. This infection is rebellious to all kinds of ordinary wound treatment. It is entirely uninfluenced by multiple incisions and drainages, hot or cold wet dressings, or the application of the ordinary disinfectant agents. Likewise, Alpine sunlamp or other forms of radiant energy are without benefit.

If an incision is made in the erythematous or reddened zone of advance, it is here that the microaerophilic nonhemolytic streptococcus will be found in pure culture, and associated with it the hemolytic staphylococcus will be found in the suede leather or zone of gangrene. It is well to excise blocks of tissue for cultural procedures and for a further study of the bacteria in the field. Meleney is convinced that the treatment of this condition demands radical excision of the whole process outside of the zone of erythema and that the application of zinc peroxide immediately after the excision will greatly aid in the control of the infection and prevent a recurrence. Only the "medicinal grade" should be used. The scalpel or radio knife may be used and any healthy granulations or normal epithelium may be left. The zinc peroxide should be sterilized in small quantities, 5 to 15 gm. at 140° C., dry heat, for four hours. It is to be applied as follows: The dry powder is suspended in approximately equal quantities of sterile distilled water so that it has the consistency of 40 per cent cream. This may be mixed with an asepto syringe and must be applied to every part of the wound surface. It is essential that the entire area be covered with the preparation. When this has been done, a double layer of fine mesh gauze soaked in the suspension of zinc peroxide should be placed over the surface and this, in turn, covered with gauze compresses or cotton wet with sterile distilled water. The whole dressing then should be sealed with several layers of vaseline gauze to prevent evaporation. After twenty-four hours, the dressings should be changed and the wound irrigated with saline solution in order to remove the exudate and old zinc peroxide. It is then reapplied as before. In about ten or fourteen days, when the whole area is covered by healthy granulations and new skin is growing in from all margins, grafts may be applied. Pinch grafts will be more satisfactory than Thiersch grafts in most cases. Complete healing may be expected in from three to four weeks after the time of excision. The recommendation is made that the skin and subcutaneous tissue should be left

widely opened and the wound packed after drainage of an intra-abdominal infection, as peritoneal contamination by intestinal streptococci and staphylococci occurs commonly.

CASE REPORT

Patient, Mr. G. L., an adult white male, aged 64 years, with past history irrelevant except for a resection of the sigmoid at another hospital eleven years ago for carcinoma. It was done in one stage, an end-to-end anastomosis being performed. This was complicated by an infection with a resulting fecal fistula which persisted for several months. There has never been any evidence of recurrence.

The present illness began with generalized abdominal pain about forty-eight hours before admission. This was accompanied by nausea and vomiting. Shortly after the onset of pain, the patient took a large dose of citrate of magnesia. This was followed by a violent purge and a temporary subsidence of the pain. After an interval of several hours, the pain returned over all the abdomen. This pain steadily increased until he was admitted to St. Agnes Hospital at 11:40 A.M. on May 8, 1938.

Examination revealed an elderly-appearing male with a temperature of 101; pulse, 90; respirations, 24; and blood pressure, 108/60. Facies were quite anxious and mucous membranes showed evidence of slight dehydration. Head and neck were essentially negative. Chest was negative. Heart sounds were of poor quality, regular, no murmurs. Inspection of the abdomen revealed a lower left rectus scar with considerable widening at its lower angle, obviously the site of the former fecal fistula. There was no evidence of hernia. Generalized tenderness and marked rigidity of the entire lower abdomen were found, together with severe rebound tenderness. The extremities were negative. The urinalysis was essentially negative. The blood count showed a marked phagocytosis with an equally marked shift to the left. A diagnosis of acute suppurative appendicitis was made. He was taken to the operating room at 12:30 P.M. and was given a general anesthetic of gas-oxygen-ether sequence.

At operation, a low, right, paramedian incision was made. Upon opening the peritoneum, there was evidence of a large amount of foul-smelling, brownish pus in the peritoneal cavity. Large and small gut were considerably distended. The serosa was markedly injected and covered here and there with plastic lymph. Two or three fecaliths were found in the gutter in the lower right quadrant. The appendix was gangrenous for its entire length. A large opening was found in the distal third through which was extruding a large fecalith; dense adhesions were found just to the left of the midline, obviously secondary to the intestinal resection for carcinoma of the descending colon done eleven years ago. A smear of the peritoneal fluid showed gram-positive and gram-negative bacilli and gram-positive cocci resembling streptococci. The culture showed *B. coli* and *B. proteus;* the gram-positive bacilli and streptococci did not grow out on aerobic cultivation. The significance of this was not appreciated at the time. Pus was removed with suction and the peritoneal cavity flushed with saline solution continuously removed by suction. The appendix was removed. A large, self-retaining catheter was inserted into the cecum and held in position with three purse-string sutures of chromic catgut. This was brought out through the lower angle of the wound. All small gut was then excluded from the pelvis and a coffer dam of rubber tissue, containing multiple gauze wicks, was inserted and was brought out alongside the cecostomy tube. The abdomen was then closed as follows: continuous plain catgut suture for the peritoneum and posterior sheath, interrupted chromic sutures for the anterior sheath, three silkworm-gut retention sutures which included the anterior sheath for the skin with clips in between. A Wangensteen tube was inserted through the nostril. The patient's immediate postoperative condition was apparently satisfactory.

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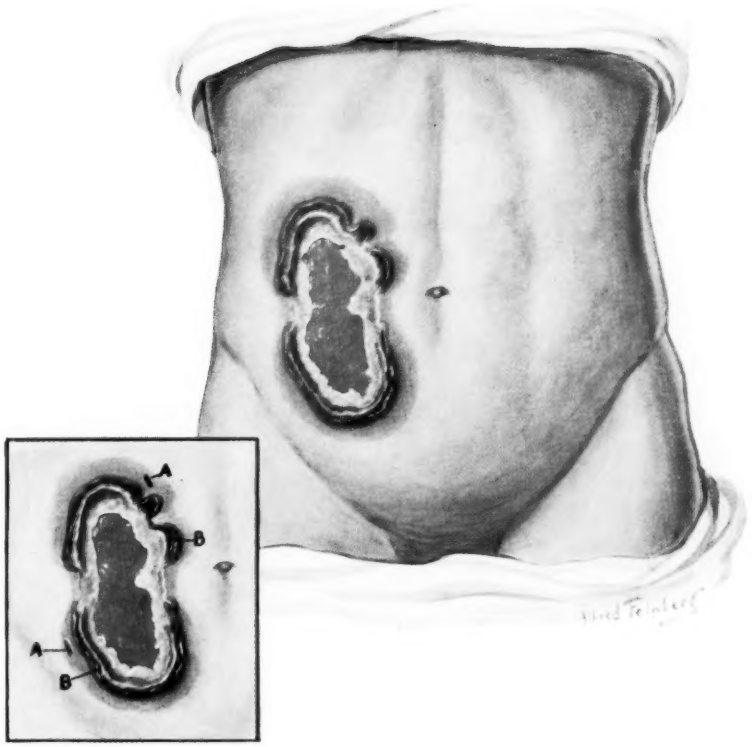

Plate I.—Illustrating lesion of progressive postoperative gangrene. *A*, Zone of advance; location of microaerophilic, nonhemolytic streptococcus; *B*, zone of necrosis; location of the hemolytic staphylococcus.

On May 10, two days postoperatively, the patient reacted quite well. He had experienced no nausea or vomiting and had but a moderate amount of postoperative pain. A transfusion of 500 c.c. of blood was given by the direct method. There was no exceptional temperature elevation postoperatively except for the second day when it reached 103° F. and then returned to normal for the remainder of his stay in the hospital. Several other transfusions were administered. There was considerable purulent drainage from the coffer dam, but the cecostomy tube functioned poorly. A moderate degree of abdominal distention was successfully combated with the Wangensteen tube. About the eighth day the drainage became dark brown in character. At the same time, at the upper angle of the wound, considerable redness was noted, especially around the retention sutures. On May 17 the patient showed less distention. He had two bowel evacuations and expelled flatus freely but there was marked anorexia. The coffer dam and the cecostomy tube were removed on the tenth day and the retention sutures a day later. His blood chemistry at this time was normal. His postoperative course was thereafter uneventful. Patient was allowed out of bed on the nineteenth day. His appetite was improved. There was very little drainage and the fistulous tract to the cecum had apparently closed promptly upon removal of the tube. Some redness persisted, however, in the skin about the site of the retention sutures. The patient was discharged on the twenty-sixth day feeling considerably stronger. The wound drainage was minimal. Three days after his return home the drainage began to increase. The lower angle of the wound showed an elevated area of the skin with marked redness and apparent gangrene of the epithelial edge. There was considerable pain in the involved area and exquisite tenderness. On the following day there was practically no evidence of any response to wet dressing which had been applied. On the next day it was very much worse and patient was readmitted to the hospital. In the next few days the infection spread with considerably rapidity. The greatest activity was at the site of the lowest retention suture just above the drain. There was considerable elevation of the involved skin and within the next few days it became frankly gangrenous, gradually taking on a suede leather color and a zone of redness extended outward for approximately 2 or 3 cm., then paled into adjoining healthy skin.

By a strange coincidence, a few months before this time, a small surgical group, of which I am a member, spent a day at the Presbyterian Hospital visiting the surgical department. Models of various types of chronic ulcerations were demonstrated in the laboratory of Dr. Frank Meleney, and among them was a case of progressive bacterial synergistic gangrene. It was obvious that my case fell into this category. The patient was therefore taken to the operating room and given a general anesthetic. The lesion at that time appeared as illustrated in Plate I. The ulcerated area was approximately 8 cm. in diameter and had an irregular outline. The gangrenous zone was interrupted in several places. The raised purplish zone indicated the area where the gangrenous process was slowly spreading. The zone of erythema initiated the process. The entire infected area was excised down to fascia which was apparently not involved. The exposed area was then covered with a zinc peroxide (DuPont) dressing as described above. The culture of the gangrenous area showed *B. proteus* and hemolytic staphylococci. Anaerobic culture of the edges of the zone of erythema outside of the gangrenous area showed nonhemolytic streptococci which subsequent transplants proved to be not strictly anaerobic but microaerophilic. Laboratory reports submitted on the excised specimens showed a widespread suppuration with destruction of skin and subcutaneous tissues and little effort at repair. The pathologic diagnosis was gangrene of the abdominal wall.

Immediately following the operation, the patient observed a very gratifying relief from the extreme pain and tenderness present in the lesion. He was, however, mentally depressed and it was difficult to secure his cooperation. He ran a spiked fever which could not be explained by the benign appearance of the wound. Daily

dressings were then applied with zinc peroxide and the wound continued to improve. Drainage decreased and the granulations began to grow actively.

On the thirteenth postoperative day the zinc peroxide treatment was stopped and I attempted to approximate the upper wound edges with adhesive plaster. This was a mistake, for another small area of gangrene about 2 by 3 cm. in diameter promptly developed in the upper part of the wound. This area was excised on the following day under gas-oxygen anesthesia. Zinc peroxide was continued and the wound immediately lost all signs of inflammation. Nevertheless, the patient's appetite was extremely poor and his mental depression was very marked. The patient repeatedly refused his meals. Several transfusions were given during his postoperative course, but they did not seem to control the general debility. On the twenty-first day postoperatively, he complained of some deep pain in the lower left quadrant, and twelve hours later he passed about four ounces of blood per rectum together with several

Fig. 1.—Healed lesion, several months postoperatively.

clots and a considerable amount of foul-smelling purulent material. It was evident that a deep-seated, intra-abdominal abscess had perforated into the colon and had evacuated itself in this way. His condition from then on showed marked improvement. His mental condition cleared and his appetite returned. The wound thereafter improved and there was no further evidence of spreading infection. A few islands of epithelium appeared spontaneously in the area of granulations which had not been removed. On the thirty-eighth day skin grafts were applied to the granulated area and the grafts took well, coalesced, and soon covered the wound. His convalescence from then on was uneventful. The patient was discharged from the hospital with two small remaining granulating areas having healthy edges. These wounds healed promptly following his return home, eighty days after the onset of his illness and fifty-four days after the development of gangrene.

DISCUSSION

This case unquestionably falls into the group of "progressive bacterial synergistic gangrene" described by Meleney and others. The lesion began in the operative wound following the drainage of a foul-

smelling peritonitis resulting from a gangrenous appendicitis. It developed later than most of the reported cases which raises the question of the source of the bacteria and the time in which the organisms first gained a foothold in the wound. They may have been present in the original peritoneal exudate or they may have entered the wound later when cecal contents leaked out around the cecostomy tube. In any event, either the pressure produced by the retention suture or by the coffer-dam drain probably played a role in the establishment of the infection and, once it became established, it spread with considerable rapidity.

Meleney has emphasized the factor of pressure in the development of the infection and has advised that no attempt be made to close the skin wound in any case in which foul-smelling abscesses are drained. After the infection had gained a foothold, the characteristic exquisite tenderness of the lesion and the change in the disposition of the patient were very striking. The cause for this has never been adequately explained. A noteworthy point during his illness was the rather marked toxicity after the excision of the lesion. This was probably due to the intra-abdominal abscess and not to the denuded area.

This deep infection probably explains why transfusions seemed to have but very slight influence toward increasing his resistance, until the deep abscess had evacuated itself through the bowel. The essential organism, a nonhemolytic microaerophilic streptococcus, which Meleney has found by anaerobic cultural methods in the zone of advance in all five of his cases, was also present in our case at the outer margin of the erythematous zone. We also recovered from the gangrenous area, associated with it, a hemolytic *Staphylococcus aureus.*

The synergistic experiments with these organisms which Meleney has performed on several occasions were not carried out. He has shown that, when these organisms are injected into laboratory animals (dogs, rabbits, guinea pigs) separately and in combinations (half doses of each), the pure culture usually failed to produce any inflammatory response while the combination almost always produced a profound purulent reaction in the tissue with gangrene of the overlying skin. While this lesion is not exactly like the human process in that it is not progressive, the experiments prove that these organisms in combination have a synergistic action which they lack when not combined.

Willard, of Tacoma, reported a similar case in 1935 and by careful laboratory work verified the results obtained by Meleney. Willard's case was likewise "characterized by slow but relentless progress, and by extreme sensitiveness of the area involved." Willard reported that with the organisms obtained from his case, four guinea pigs were given subcutaneous inoculations. The hemolytic streptococcus first obtained from the area of slough produced an abscess which cleared up. The nonhemolytic streptococcus from the zone of advance produced a small abscess. In contrast, the hemolytic staphylococcus and nonhemolytic

streptococcus injected together produced a large spreading ulcer of the skin and early death of the guinea pig. An understanding of the essential nature of this symbiotic infection simplifies proper treatment. It is obvious that wide excision is necessary to get control of the infection.

Whether scalpel or radio knife is used is of minor importance. Meleney prefers the knife because it means a minimal surface of injured tissue. Willard in his monograph stated: "It is probable that if radical excision is performed, a special dressing is of minor importance in controlling the infection." I cannot entirely subscribe to this, but I do believe that one need not be quite so radical in the excision where the zinc peroxide is used, as it was evident that the recurrence in my case was observed following radical excision and shortly after discontinuing the zinc peroxide. This unfortunate result emphasizes the folly of trying to approximate wound edges by means of adhesive. This naturally causes an infolding of the skin edges and the resultant angles produce minute pockets in which colonies of the causative germs may develop by producing or finding an anaerobic "soil."

DIFFERENTIAL DIAGNOSIS

This condition must not be confused with the undermining, ulcerating type of infection due to the microaerophilic hemolytic streptococcus. These burrowing tracts extend deeply and the undermining process proceeds as far as 4 to 5 cm. beneath the skin edges. This is not accompanied by gangrene and is caused by the microaerophilic hemolytic streptococcus, no symbiotic hemolytic staphylococcus being here associated.

A human bite nearly always contaminates the wound with a mixture of organisms. Many surgeons justly fear these infections because, ordinarily, gangrene frequently occurs here when there is a mixture of organisms which includes anaerobic nonhemolytic streptococci, fusiform bacilli, and spirochetes. It has been observed that, while spirochetes are never found alone in these infections, the worst one always reveal that spirochetes are present. With a fusospirochetal infection, we have a fulminating lesion spreading and penetrating deeply and soon involving deep tissues, including bone, with overwhelming destruction. It may occasionally be necessary to differentiate progressive postoperative from an amoebic gangrene. However, in this situation we have frequently a history of amoebic dysentery. Amoebae may be found in the stools or there probably will be found some other evidence of a deep amoebic lesion. Again, this condition responds promptly to emetin treatment. This lesion is also deeper, develops rapidly, and usually invades the muscle. Pressure on the margins produces glairy pus in which the amoeba may be found. Meleney's investigations of this condition have shown that this exudate "almost invariably yields,

besides the amoeba, a combination of organisms which may be contributing toward the severity of the infection."

A diagnosis of postoperative gangrene should be made within a week or ten days after the onset. A suspicion of the nature of the infection should be aroused by the clinical course. The diagnosis can only be made with certainty by adequate bacteriologic analyses of the flora of the wound. Early diagnosis is essential to early treatment which will save the patient an infinite amount of time, pain, and expense and will minimize the destruction of skin. Every hospital should have available apparatus and materials necessary to perform anaerobic cultures.

What the effect of the administration of sulfanilamide or sulfapyridine might have been in this situation, I do not know. They were not tried here.

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THE KELLER OPERATION—PARTIAL PHALANGECTOMY IN HALLUX VALGUS AND HALLUX RIGIDUS*

Report of 55 Operations in 32 Cases

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THE problem of hallux rigidus and hallux valgus is a very complex one. Results are very difficult to gauge accurately. In 1930, Timmer (quoted by Bentzon) described twenty-five different procedures for hallux valgus. Since then, modifications and new procedures have continued to reappear. This indicates that none is accepted as the operation of choice in all cases. The results in general are far less satisfactory than the ordinary attention paid to them would suggest. Haglund has divided hallux valgus cases into two groups: (1) patients treated by others, who then consulted him; and (2) patients he had treated, who then went to others.

Hamsa, reviewing 339 operations for hallux valgus at the University of Iowa clinic, concluded that only somewhat over one-half of the cases had "good" results with the Mayo operation (61 per cent). With the other operations, the "good" cases ranged from 57 down to 19 per cent. However, actual poor results were uncommon. The remainder were considered fair. At the international orthopedic meeting at Cologne in 1926, a combined report on the results of surgery in hallux valgus, based on hundreds of cases, was presented. Only 50 per cent were considered perfectly satisfactory results, the rest ranging from fair to poor. There are but a limited number of types of operations for these conditions, but each has been discovered and rediscovered several times. These are given with associated authors, as compiled by Hamsa and from other sources, in Table I.

The soft tissue operations, with or without exostectomy, have been used in mild cases, partly in a prophylactic way, and have a definite indication. They produce rapid convalescence with relief of symptoms if indications have been correct; that is, painful bursa over an exostosis, with little or no actual hallux valgus.

Osteotomies of the metatarsal neck, shaft, and base have corrected deformities of the most severe hallux valgus cases. The objection of prolonged convalescence and delayed return to work has prevented them from gaining wide adherence. The altered weight bearing in shortening or plantar flexing the first metatarsal shaft is the cause, in addition

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TABLE I

1. Exostectomy	Schede
2. Exostectomy and capsuloplasty, soft tissue and tendon procedures	Silver, McBride, Porter, Roberts, Hiss, Payr, Stanley, Leuggenhagger and others
3. Resection of first metatarsal head	Hueter, Mayo, Perkins, Roth, Soresi, Lexer, Fowler, Ombredanne, Cleveland, Broca, Bentzon and co-workers
4. Resection of proximal phalanx plus first metatarsal exostectomy	
a. Total	Alsberg
b. Partial	Daries-Colley, Keller, Girdlestone, Brandes, Lindemann and Meyerhof, Kaspar, McMurray, Galland and Jordan
5. Wedge resection of metatarsocuneiform joint plus plastic procedure at metatarsophalangeal joint	Riedl, Truslow, Kleinberg, Lapidus
6. Wedge resections of metatarsal neck	Hohmann, Reverdin, Mauclaire, Peabody
7. Osteotomy metatarsal shaft	Ludloff, Chlumsky, Cotte
8. Arthrodesis of metatarsophalangeal joint	Mauclaire

to the long healing time of such osteotomies. Wedge resection of the first metatarsocuneiform joint undoubtedly gives good results when done meticulously, combined with a complicated plastic procedure at the metatarsophalangeal joint. However, much more skill is required and recovery is frequently so prolonged as to make the radical cure of bunions a major procedure.

Resection of the metatarsal head, since first done by Hueter and popularized by Mayo in 1908, has been widely used in the worst cases of hallux valgus. It has the advantage of simplicity, complete correction of deformity, and shortening of the first metatarsal segment to prevent recurrence. However, removal of the first metatarsal head removes one of the important weight-bearing bones and tends to aggravate or produce an intractable metatarsalgia. Painful calluses form under the second and third metatarsal heads or stump of the first metatarsal shaft. It is well known among the laity as an operation requiring a prolonged convalescence and has added to the fear of hallux valgus operations as major procedures.

Resection of the proximal part of the first phalanx of the great toe has been proposed as an alternative procedure, to take care even of severe deformity, give a rapid convalescence, shorten the toe, and produce no fundamental changes in the weight-bearing mechanism of the foot.

REVIEW OF THE LITERATURE

The operation appears to have been done by Davies-Colley in 1887, and later by Henback and Clarke. In 1904, Keller, a United States Army surgeon, proposed this method as the standard one for dealing with hallux valgus, presenting three successful cases. His technique was essentially the same as it is done today.

Brandes, in 1928, systematized the operation and reported on over 100 cases. He did extraperiosteal resection of two-thirds of the phalanx combined with metatarsal exostectomy. Splinting was by adduction and plantar flexion, maintained by plaster. His results and after-care were very similar to what we have adopted.

Kaspar, in 1933, reported a series of 31 such operations. He used more plantar flexion to prevent dorsiflexion contractures and less adduction splintage, and he made the point that in some cases even wound infection and stiffness produced no symptoms, the patients being very happy.

McMurray, in 1936, discussed the problem of hallux valgus and presented as his most favored procedure the resection of well over one-half of the proximal phalanx. He claimed that this tended to correct the deviation of the first metatarsal from the second. He recommended subcutaneous tenotomy of the extensor hallucis longus, at a distance from the incision, in cases where this tendon appeared to be acting as a deforming force after the bone had been removed.

Lindemann and Meyerhoff in 1936 reported a follow-up study of 64 of 80 cases operated upon. Their general procedure resembled that of Brandes, but they advocated lengthening the extensor hallucis longus tendon when marked dorsiflexion of the great toe persisted after resection of the phalanx. They had 104 operations, of which 52 feet were perfect and 40 feet had mild complaints referable to existing splayfoot, flatfoot, slight valgus of the toe, or too noticeable shortening or mild dorsiflexion. The function in these was very satisfactory. In 12 cases the results were poor, due to recurrence in 4 and marked stiffness in 8, although only 2 complained of disability.

Lloyd, in 1936, reported a series of 20 cases of bilateral hallux valgus in which hemiphalangectomy was done on one side and the metatarsal head resection on the other. After one year, there was no difference, based on subjective feeling of pain only. No statement as to cosmetic or functional result was given. In addition, he did not mention the amount of phalanx resected, though a photograph showed only about one-fourth to be removed. He claimed metatarsalgia was uninfluenced by either operation and that the results of metatarsal head resection were as good as the other if one waited long enough.

Galland and Jordan presented the first paper in the American literature since Keller's on this subject, in 1938. They recommended post-

operative fixation by traction in a plaster cast, by means of a silk stitch through the toe tip, for one week.

All authors who advocate partial phalangectomy emphasize the short convalescence, the rapid ambulation, and the speedy return to full working capacity, although the toe continues to improve for the first several months.

ANALYSIS OF PRESENT SERIES

Selection.—Thirty-two cases of hallux valgus and hallux rigidus had this operation at the Mount Sinai Hospital from 1935 to six months ago. Further follow-up to date has not altered the results. Concurrently, many simple exostectomies were done, so that the phalangectomized cases indicate the more severe types. This is not an end-result study, but a consideration of the Keller-Brandes operation and our experiences with it. Some of the sources of error will be presented in an attempt to improve the results. While the operation is in wide use in at least two of our orthopedic hospitals in New York, only one paper has been published in the American literature on the subject since Keller's original contribution. We believe it is deserving of more attention.

The statistics are given briefly in Table II. Most of the operations on the ward service were done by the orthopedic resident or a junior interne, under attending staff supervision, indicating the relative simplicity of the procedure. There was a slight preponderance of cases in the decades from 30 to 60 years of age, but not significantly so.

We would say now that in certain types of hallux valgus cases this operation alone is not enough. Thus, patients with a marked splayfoot,

TABLE II

55 CASES OF PARTIAL PHALANGECTOMY

No. of patients		32
Ward	24	
Private	8	
Bilateral	23	
Unilateral	9	
Male	6	
Female	26	
Age	15-69 years (evenly distributed)	
Follow-up		6 mo. to 3 yr.
Hallux rigidus		8 feet
Hallux valgus		48 feet
Reoperations (3 cases)		4 feet
Results		
Group I	17 feet	
Group II	11 feet	
Group III	10 feet	
	38 feet (70%)	
Group IV	11 feet (20%)	
Group V	6 feet (10%)	
Total	55 feet (100%)	

which is not rigid, that is, young persons, should be treated by additional measures. Two of our cases had the encircling fascial loop operation suggested by Krida. Patients with a very rigid, arthritic foot, and with marked metatarsus varus primus, so that simple exostectomy will not relieve the prominence of the metatarsal head, should have the head resected. In associated cavus or clawfeet, lengthening, transplantation, or tenotomy of the extensor hallucis longus is in order, or even midtarsal wedge resection.

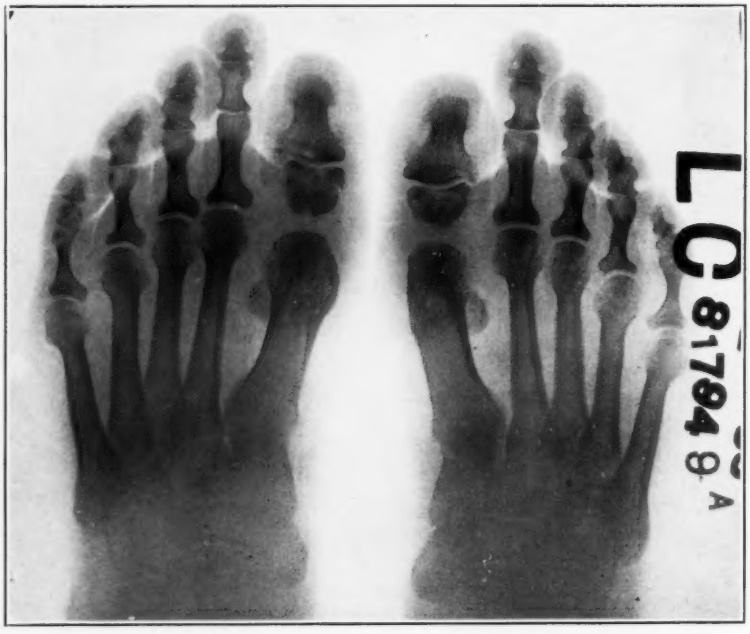

Fig. 1.—Typical resection of two-thirds of phalanx. Good clinical result.

Points in Operative Technique.—

1. The incision may be dorsomedial or directly medial but should not be curved around a bunion. A straight incision heals better.

2. In many of our cases the phalanx was resected largely subperiosteally and the clinical results were not greatly unlike those done extraperiosteally. The former is technically much easier, although the dissection at the joint capsule must be done by sharp methods in either case. In both, care must be taken not to injure the flexor hallucis longus tendon which is very adherent to the joint capsule and base of the phalanx on its plantar aspect.

However, in a small number of the younger patients, regeneration of bone occurred in the form of spurs from the stump of phalanx or even larger pieces occupying the space left between the phalanx and metatarsal head. We are now of the opinion that extraperiosteal resection is preferable, the section of the phalanx to be made by a saw, after delivery of its proximal portion into the wound, or by bone cutting

forceps which necessitates some splintering and subsequent smoothing of the edges.

3. The amount of bone removed is the most important single factor in the entire operation. At first, only the proximal one-fourth or one-third of the phalanx was removed, but this gave poor results in the first few,

Fig. 2.—Partial phalangectomy for hallux valgus, showing cosmetic result obtainable. Excellent clinical result.

causing partial or complete fusion of the joint. Even in these, the functional result was satisfactory in most, though hardly ideal. We now resect between one-half and two-thirds of the bone. Removing less, we have the risk of stiffness and pain. Removing more, we get too much shortening of the great toe, with a less satisfactory appearance and control of the digit. Since the hallux is usually unduly long in cases of hallux valgus, a moderate amount of shortening of the great toe is an advantage and positive necessity in permanently correcting the deformity.

Fig. 3.—Partial phalangectomy (two-thirds and one-half) for spastic hallux valgus. Good clinical result.

4. We have attempted to cover the raw stump of phalanx, either by a flap of capsule or periosteum or by approximating the inner and outer walls of the cavity left by the bone resection. In some cases, it has not been harmful simply to close the outer fascial structures without attempting closure of dead space. The toe is very floppy at first

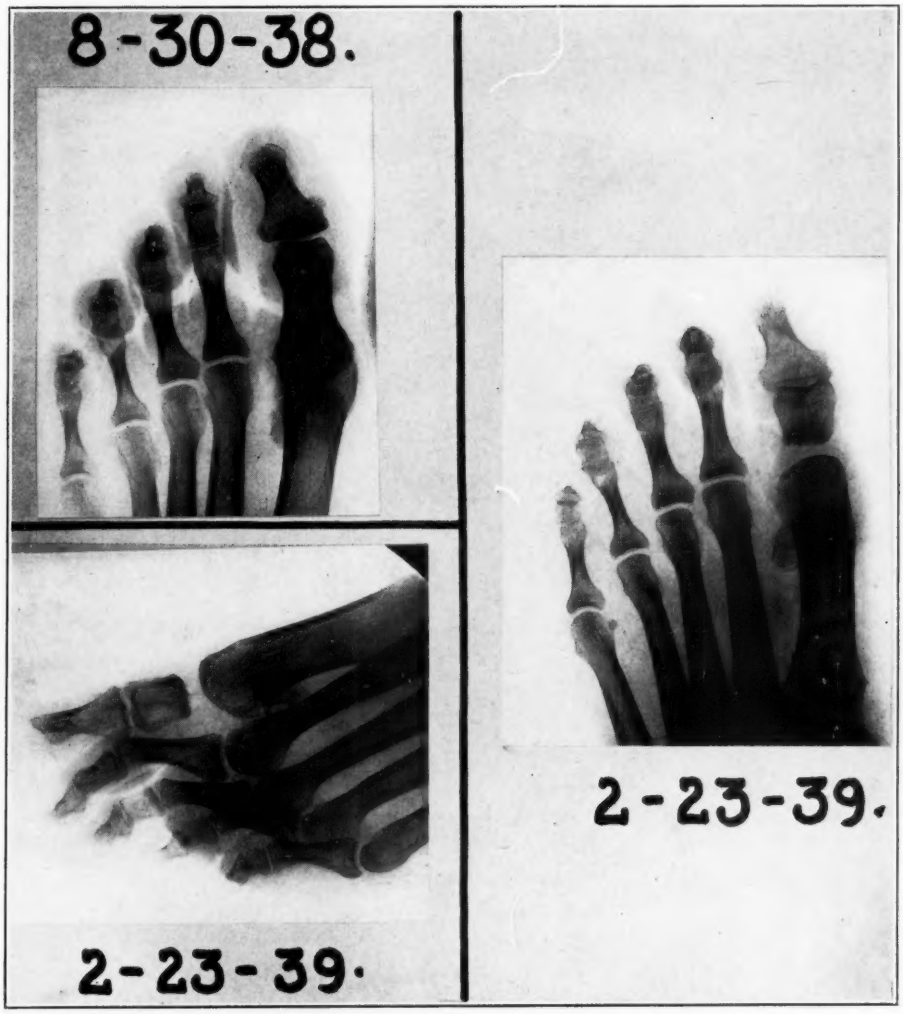

Fig. 4.—Typical partial phalangectomy for hallux rigidus. Only fair clinical result. Slightly more bone should be removed.

and has abnormal lateral mobility for some months. This does not interfere with function and the dead space is quickly obliterated as the joint tightens up. Full control of the toe occurs at about three to four months.

Points in Postoperative Care.—

1. In most of our cases, a simple sheet-wadding and bandage splint was made to maintain the toe in marked adduction and plantar flexion

for one week. This led, in 5 or 6 feet, to formation of a crease at the metatarsophalangeal joint with localized slough of skin. There was no interference with convalescence other than the necessity to maintain a dressing for four to five weeks. In most of the cases this did not happen, and we believe that fixing the toe in but slight adduction and plantar flexion will prevent this. We used fixed traction with a

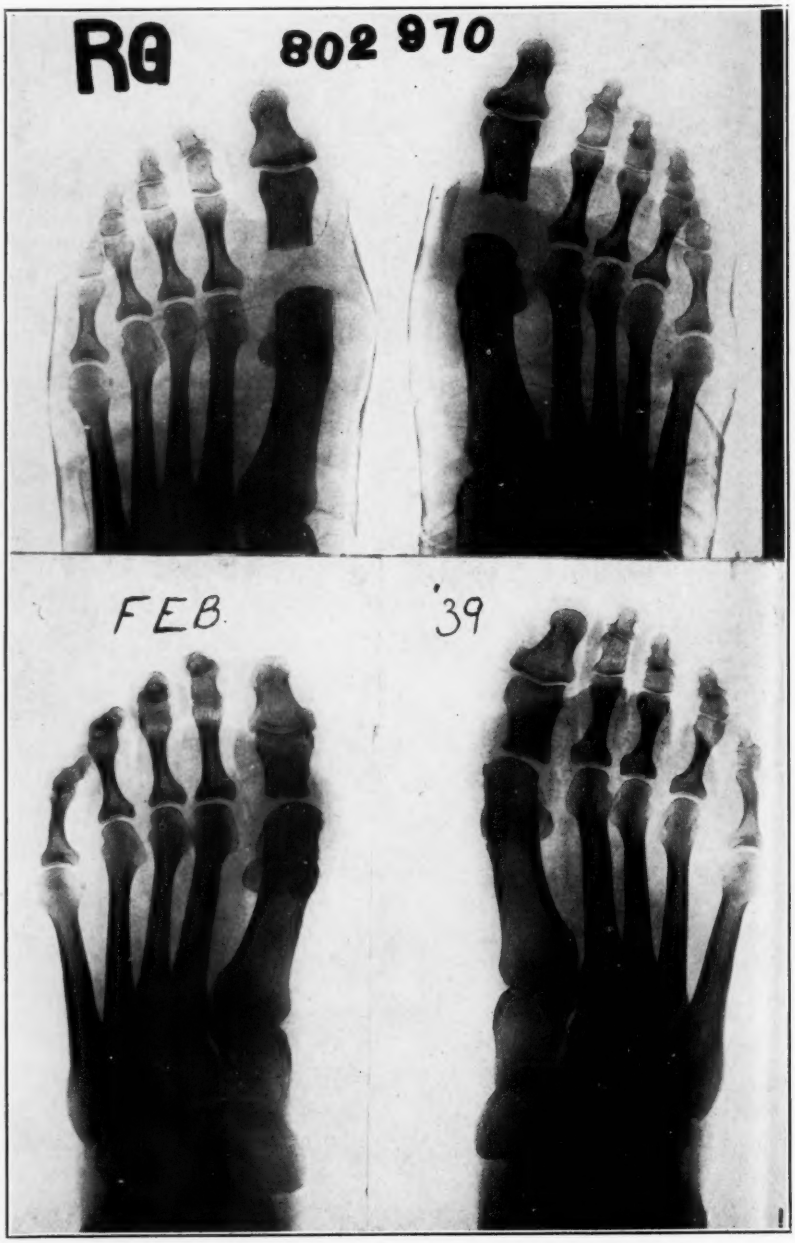

Fig. 5.—Hemiphalangectomy, postoperative, bilateral, for hallux valgus, indicating the tightening up of the originally extremely lax joint. February, 1938, immediately postoperative. Excellent clinical result.

stitch through the toenail in several cases with no difference in convalescence.

2. No significant wound infections occurred, although one sinus after a skin slough persisted for a few weeks. The only other complications were a single case of phlebitis and an intercurrent mild respiratory infection.

3. After one week to ten days, the toe is allowed to return to the neutral position. The patient is out of bed in a week, walking by the end of two weeks with a cutout shoe, and discharged from the hospital.

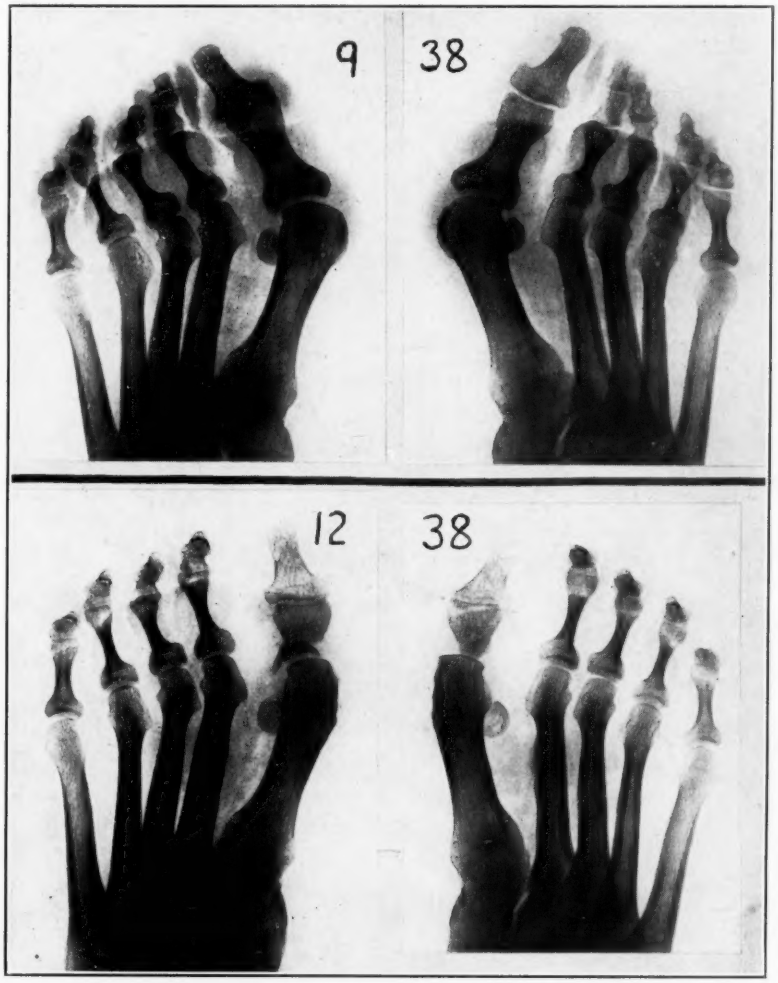

Fig. 6.—Partial phalangectomy (two-thirds) in a young girl, resected subperiosteally. Note bone regeneration in new joint space, bilaterally, left much more than right. Fair clinical result.

4. In the last one-half of the cases, the forefoot has been supported in most cases by a circular compression dressing of zinc gelatin bandage or adhesive for a period of weeks. About one-half the patients used metatarsal arch supports for some months.

5. Most of the patients were back on full duty or full activity in three to four weeks, doing such things as general duty nursing, waiting on table, playing golf, etc. By the end of six weeks, practically all were restored to their usual activities.

RESULTS

In evaluating any procedure, much depends on the criteria used by the man rating the cases. These were divided into five categories:

Group 1, Excellent.—No pain was present in the great toe. There was normal, or practically normal, motion with no aggravation of long arch or metatarsal pain, with perfect cosmetic result. Seventeen feet were of this type.

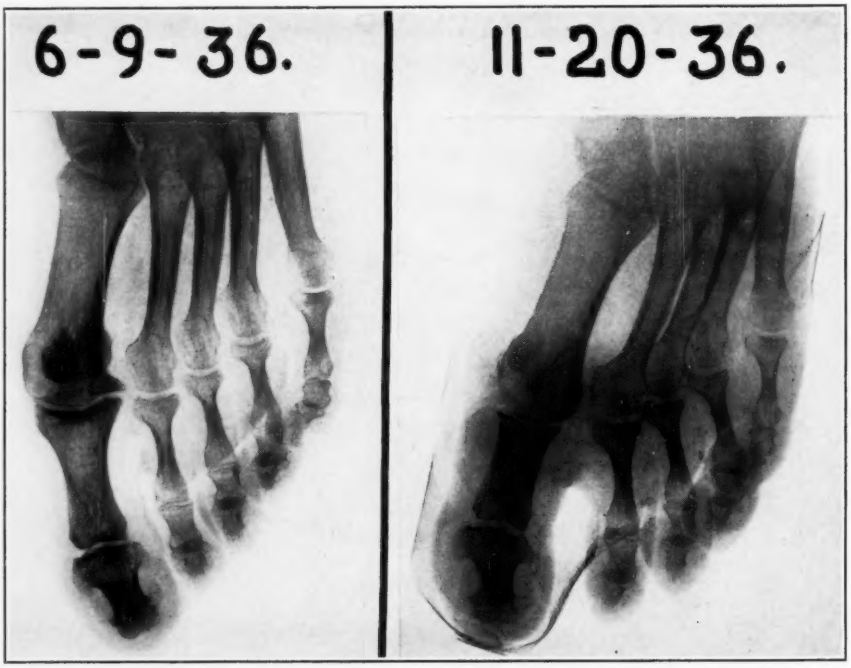

Fig. 7.—Insufficient bone resection for hallux rigidus; one of our first cases. Fibrous ankylosis and a poor result occurred.

Group 2, Good Results With No Details.—This group included those in which I did not personally examine the feet in follow-up, mainly being private cases of the other men on the staff. None of these had symptoms remaining after operation; all had good motion and perfect cosmetic result. Ten feet were of this type.

Group 3, Good.—In this group were included those with no or slight occasional discomfort in the new joint, slight limitation of motion, tendency to dorsiflexion of the great toe when at rest; or those with slight recurrent or persisting hallux valgus, but with the toe not at all or slightly shorter than the second toe. Eleven were such feet.

Group 4, Fair.—This group covers those greatly improved by the operation, with the patient satisfied, but with some specific defect, such as (a) some pain in the articulation, (b) considerable limitation of motion, (c) permanent dorsiflexion of great toe, (d) aggravated metatarsal or long arch pain, (e) too noticeable shortening of the toe, or (f) too much regeneration of bone. Eleven feet were of this type, the greater number being due to limitation of motion and slight dorsiflexion contracture of the toe, accompanying a general tendency to mild or moderate clawing of all the toes and prominence of the metatarsal heads.

Group 5, Poor.—Those with too much pain, fibrous ankylosis, or much worse metatarsalgia or long arch pain are included here. Only six feet were of this type.

DISCUSSION

Grouped together, 38 of 55 feet, or 70 per cent, were excellent or good; 11, or 20 per cent, were fair; and only 6, or 10 per cent, were failures. These results compare favorably with almost any type of hallux valgus operations where true attempt is made to correct the deformity permanently. They resemble the reported German results.

The future results should be even better. Most of the poor results were in the earliest cases where not enough bone was resected. Several of the poor and fair results occurred in patients with marked deformity, but without preoperative pain in the bunions. In such patients, the possibility of slight postoperative symptoms should be discussed before embarking on cosmetic surgery.

In our hallux rigidus cases especially, the tendency was not to remove enough bone as there was no deformity to correct. Of 7 such cases, the first 3 in our series were poor on account of this. Two were fair and 2 were good or excellent. In view of the great stiffening tendency, probably more bone should be resected than in hallux valgus, but in unilateral cases the difference in great toe length should be discussed with the patient beforehand.

Reoperations.—Three cases had secondary operations, approximately one year after the first. One was a bilateral hallux rigidus case which developed postoperative ankylosis due to insufficient bone removal. Reoperation produced a better result but the follow-up is insufficient to include this. The other two, also bilateral, were operated upon for residual pain with restriction of motion in one toe. In each case, the result was fair but the patient wanted it to equal the other foot, which was perfect. Removal of a further small amount of bone in these cases produced an excellent result in one and a fair result in the other, where the joint space and metatarsal head were fused with the phalanx by a mass of fibrous adhesions. Three other poor and fair cases have been advised operation, another advantage of this procedure.

X-Ray Findings.—In no case in which we had pre- and postoperative films to compare was there an increase in the width of the foot or splayfoot. The feet were diminished in width by the exact amount of exostosis removed from the first metatarsal head. The films were not made in weight bearing, however.

McMurray states that after partial phalangectomy the angle between the first and second metatarsal segments, so commonly increased in hallux valgus, tends to decrease. Measurements in fourteen of our cases did not confirm this.

Measurement of the metatarsophalangeal angle, as an expression of the correction of hallux valgus, showed much correction in all cases, averaging 20 degrees. This measurement had no direct relationship to the gross cosmetic result. Some feet with relatively few degrees of correction showed an excellent cosmetic appearance. The more severe the hallux valgus before operation and the larger the angle, the greater correction was obtained in degrees. Lumping all cases, the postoperative average angle was 22.5 degrees, and yet many of the cases showed a perfect cosmetic appearance.

CONCLUSIONS

1. Partial phalangectomy plus exostectomy of the first metatarsal head is a simple, efficient operation for the radical cure of ordinary, severe hallux valgus and hallux rigidus, provided proper attention to detail is given.

2. Extraperiosteal resection of one-half to two-thirds of the phalanx should be done in hallux valgus. In hallux rigidus nearer two-thirds should be removed.

3. A simple pressure dressing in the neutral position will prevent creases and the possibility of a slough in the incision.

4. The forefoot should be supported by a circular compression dressing for some weeks, and followed, if necessary, by metatarsal arch supports.

5. If these details are observed, eminently satisfactory results will be obtained. Convalescence should be rapid, with painless walking in two weeks, and return to full activity in three to five weeks. Laxity of the joint will disappear in three to four months.

6. Symptoms due to other associated foot conditions will not be altered by any hallux valgus operation.

I wish to thank Dr. Seth Selig, Dr. Robert K. Lippmann, and Dr. Edgar Bick for the privilege of studying their cases, ward and private.

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PRINCIPLES GOVERNING THE TREATMENT OF FRACTURES AND BONE LENGTHENING BY DIRECT SKELETAL MEANS AND A NEW APPARATUS

Preliminary Report

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FRACTURES and their management have been of deep and universal interest to the medical profession for many centuries. Records dealing with their study may be found to go back to the Egyptians of 4,500 years ago, and the basic principles underlying our present-day management of acute closed fractures were laid down by Hippocrates as long as 2,000 years ago. It is interesting to note that the various methods and devices for early treatment recommended by Hippocrates remained virtually unchanged until the nineteenth century, when Sir Ashley Cooper's "Treatise on Dislocations and Fractures of the Joints" opened a new path and stimulated renewed interest in the subject.

The important result of this was the first step in the development of our knowledge of the treatment of acute fractures by direct skeletal means.

The purpose of this paper is twofold: (1) to enlarge upon the principles of this significant development, as a result of the knowledge gained by the use of this form of therapy in more than sixty cases of bone lengthening and fractures; (2) to present a new apparatus based directly upon these principles.

There is little doubt that the management of acute fractures by direct skeletal means is a distinct contribution to the care of the maimed. This form of therapy, the result of slow arduous endeavor by the masters of the past century, has brought about a change in our philosophy of the management of acute fractures. The dictum as propounded by Hippocrates "extension of fractured or dislocated bones is not to be delayed to the third day, but is to be carried out on the first day," or better, immediate or early treatment, is no longer sufficient because the word ambulatory is lacking. The keynote of treatment today is immediate or early ambulatory treatment in properly selected cases. For acute fractures, otherwise extremely difficult to manage, may now be immediately and easily reduced and may readily be made ambulatory by direct skeletal means.

Barton laid the foundation of this science when he wired acute fractures of the patella in 1834, although Moreau, in France, had un-

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successfully treated cases of nonunion by this means in 1805. Thus, internal fixation was the first cardinal principle of the treatment of acute fractures by direct skeletal means. Further development of our knowledge progressed rather slowly; approximately 100 years elapsed before Codivilla, in 1903, introduced skeletal traction by driving a steel carpenter's nail through the os calcis for a fracture of the femur. This was a great advance, for, as pointed out by Codivilla, "no longer need one expect terrific skin sloughs so commonly encountered following the use of external spicas to maintain distraction." It was soon seen that skeletal traction was most efficient when applied to the bone involved. Ombredanne, though unsuccessful, was the first to attempt a skeletal traction apparatus. It remained for Putti to succeed in this accomplishment when, in operative lengthening of the femur, he used one pin to suspend each fragment. In 1927 an American orthopedic surgeon, Abbott, put the matter upon a more practical basis when, in operative lengthening of the tibia with a four-pin device, he used two pins to suspend each fragment. With the appearance of his writings, added impetus was given this absorbing subject.

In 1932 a four-wire, leg-lengthening device was described, with the following innovations[1]:

1. The apparatus used Kirschner wires (introduced in 1909) instead of the heavier Steinman pins, thereby diminishing the possible danger of introducing infection.

2. The device had vertical uprights to grasp the wires. Thus the extremity was readily accessible, and plaster of Paris could be easily applied with the apparatus in situ.

3. It had means of correcting any change in the angular relationship between the fragments of a severed bone.

However, a disadvantage of this apparatus was that it manipulated the fragments of a severed or broken bone at pivotal points away from the point of severance.

Soon several other apparatuses employing skeletal suspension and skeletal traction were introduced for the reduction of fractures. They did a great deal to popularize the immediate mechanical fluoroscopic means of reducing fractures otherwise extremely difficult to manage. However, these devices, too, manipulate the fragments from two pivotal points away from the site of fracture and employ the two-pin method of suspension (one pin through each fragment).

Another apparatus is here presented for the treatment of fractures and for bone lengthening. It is not presented merely as something new, but rather as something different in principle. This device suspends the proximal fragment in a definite immovable position and manipulates only the distal fragment at a pivotal point at the site of fracture, thereby aligning and effecting reduction with the least amount of trauma. The four-wire method of suspension is specifically

recommended; i.e., two wires through each fragment. The apparatus further provides an easily controlled precise method of reducing fractures otherwise extremely difficult to manage by other than completely open means. With the apparatus presented, a closer and more accurate apposition of the fractured ends of the broken bone may be obtained, thus favoring a more rapid union and shorter convalescence. A description of the apparatus will follow later. It is to be noted here that the apparatus is based upon the principles which are believed to be applicable to any method of treatment of a fractured or severed bone with displacement of the fragments. These principles are as follows: (1) immediate or early ambulatory treatment, (2) suspension, (3) traction, (4) manipulation and reduction, and (5) fixation and immobilization.

1. *Immediate or Early Ambulatory Treatment.*—It is believed that the time is not very far removed when certain types of fractures will not be seen occupying beds in traumatic wards. Immediate or early refers only to the time interval between the incidence of fracture and institution of treatment.

2. *Suspension.*—Suspension is perhaps the all-important basic principle in the treatment of a broken or severed bone. A broken or severed bone is usually in suspension from the moment the extremity is raised until it is returned to a position of rest. When the fragments of a broken bone are suspended, let us assume a constant fixed relationship between each suspending object and its fragment of bone. Then, should the suspending objects be distracted and so maintained, then the fragments will be distracted. Should the suspending objects be manipulated in such a way as to reduce the fracture and be so maintained, then the fracture will remain reduced. When fixation of the fragments and immobilization are executed and suspension is discontinued, the limb may be returned to a position of rest. Two conclusions may be drawn from the foregoing:

A. The treatment of a fracture with displacement of the fragments is dependent chiefly upon suspension with a fixed constant relationship between the suspending object and its fragment of bone; i.e., adequate suspension. Adequate suspension includes ready accessibility of the broken extremity.

B. With adequate suspension and sufficient force properly directed upon the suspending objects, the treatment of a fracture becomes a comparatively simple problem.

Thus the treatment of a fracture by direct skeletal means is chiefly dependent upon adequate suspension.

If the time consumed by suspension in the treatment of a broken bone is graphically represented, an interesting comparison is revealed (Fig. 1).

The time consumed by the execution of each of the above principles varies, of course, in different cases, but, as indicated above, the length of time consumed by suspension is always greater than the sum total of the time consumed by the execution of the remaining principles. This is, I believe, true, regardless of the method used in the treatment of a broken or severed bone, because suspension is in force during traction, manipulation, reduction, fixation, and immobilization.

Theoretically, adequate suspension by direct skeletal means may best be accomplished by passing four wires through a suitable fragment of bone, two in a horizontal plane and two in a vertical plane, separated as far as possible. By this means, vertical or lateral mobility and angulation are rendered impossible. However, a practical, efficient, and thoroughly proved plan of adequate suspension merely requires the use of two wires drilled through a suitable fragment of bone and separated as far as possible. Padded metal shields are placed firmly against the involved extremity and fixed to the wires. Thus, vertical or lateral mobility and angulation are eliminated.

Fig. 1.—Graph showing schematic presentation of the time consumed by the principles employed in the treatment of a broken bone.

Adequate suspension is, I believe, the all-important basic principle in the therapy of fractures by direct skeletal means. It has been my experience that the gravest pitfalls lie in inadequate suspension. It is in inadequate suspension that most errors are made, with their subsequent untoward consequences. One wire through a fragment of bone merely acts as a pivot. At least two wires inserted in accordance with the above principles are necessary to adequately suspend a suitable fragment of bone. Only thus can vertical or lateral mobility and angulation be eliminated and infection, deformity, and pressure necrosis prevented.

3. *Traction.*—All things being relative, a linear displacement of one of the fragments of an adequately suspended broken or severed bone will suffice to alter the relationship between the two fragments.

4. *Manipulation and Reduction.*—What has been said under the heading of traction also applies to manipulation. Only one fragment need be manipulated to alter the relationship between the fragments of a severed or broken bone. Bringing the distal fragment in line with the upper has been the method preferred to date. I believe, however, that bringing the distal fragment in line with the upper with the center of rotatory motion at the site of fracture is actually the better method

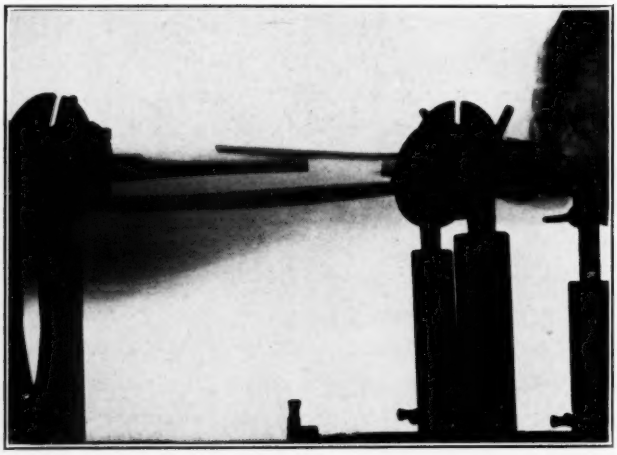

Fig. 2.—Case of bone lengthening, showing anterior angulation of the fragments with the pivotal point of motion at the distal end of the proximal fragment.

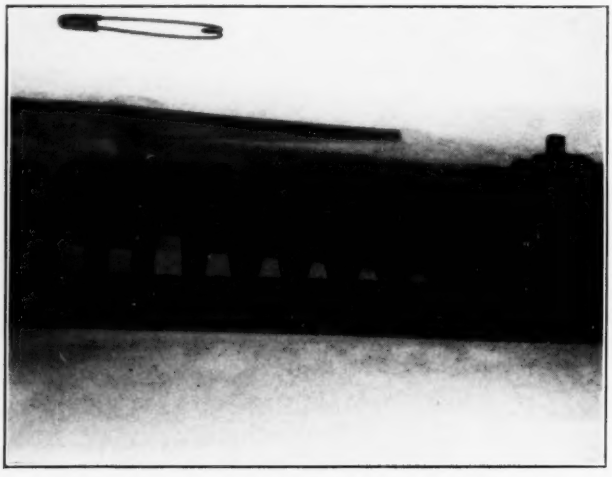

Fig. 3.—Case of bone lengthening, showing anterior angulation of the fragments with pivotal point of motion at proximal end of distal fragment. Note soft tissue shadow of calf, indicating that knee is to left side of page.

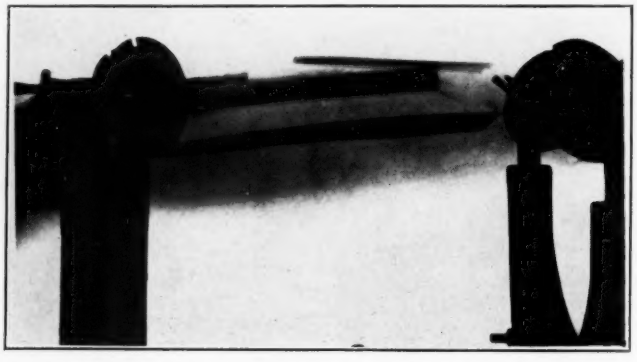

Fig. 4.—X-ray showing fracture of the distal tongue of bone in a case of bone lengthening following an attempt to correct anterior angulation of the fragments. A direct result of undue pressure because distal fragment was manipulated at a point away from the distal end of the proximal fragment.

of manipulation. In one case the center of motion may be at the distal end of the proximal fragment and in another at the proximal end of the distal fragment, as seen in Figs. 2 and 3.

When the center of rotation is moved away from either of these points, the amount of motion is increased at the site of fracture. This results in additional trauma and may also mean serious injury to some vital soft tissue structure or bone. However, by placing the center of motion at the distal end of the proximal fragment or at the proximal end of the distal fragment, as the case requires, there is the least amount of motion at the site of fracture. The method of manipulation is therefore extremely important.

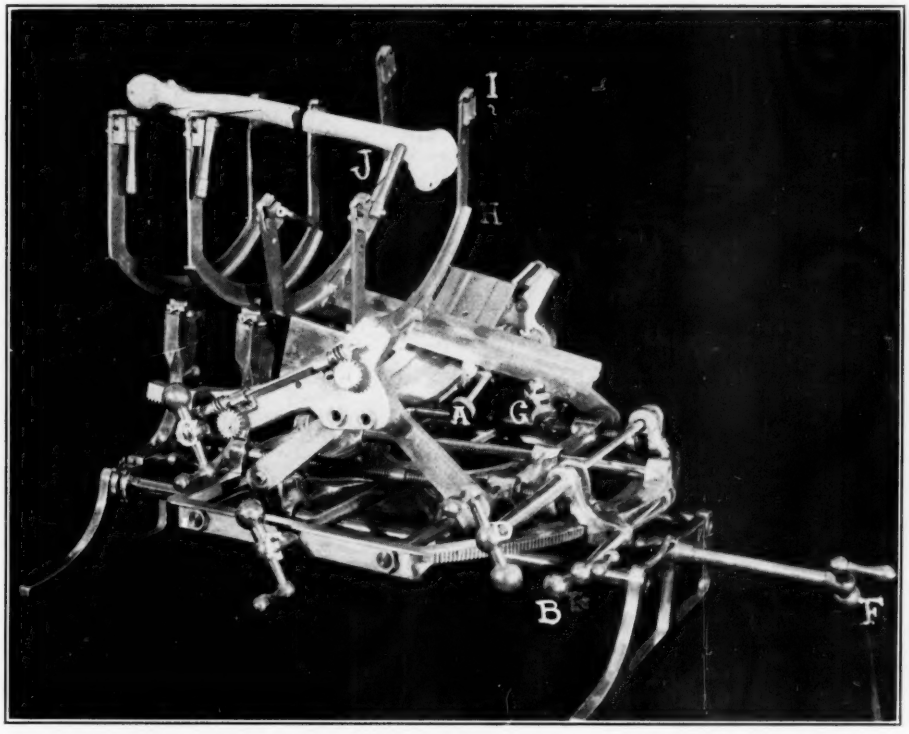

Fig. 5.—*A*, Knob for axial rotation of distal fragment; *B*, handle for pivoting distal fragment in a horizontal plane at a point at the distal end of the proximal fragment or at the proximal end of the distal fragment, as the case requires; *C*, handle for a pivoting distal fragment in a vertical plane at a point at the distal end of the proximal fragment or at the proximal end of the distal fragment (see Fig. 6).

On reduction, the consensus is in favor of absolute anatomical realignment of the fragments.

5. *Fixation and Immobilization.*—If the fragments are adequately suspended in accordance with the above principles, fixation is readily applicable. A proved method of fixation has been described in the article previously referred to. The method employs both internal skeletal and external fixatory means. Possible displacement of the fragments is thereby reduced to a minimum, thus practically eliminating resulting pressure

necrosis and permitting safe early weight-bearing. Danger of introducing infection by displacement of the fragments on the wires is also practically eliminated by the above method.

If fixation of the fragments of a severed or broken bone is absolute, immobilization is superfluous. For this reason, for the sake of clarity, it is perhaps best to confine the meaning of immobilization to the locking up of contiguous joints.

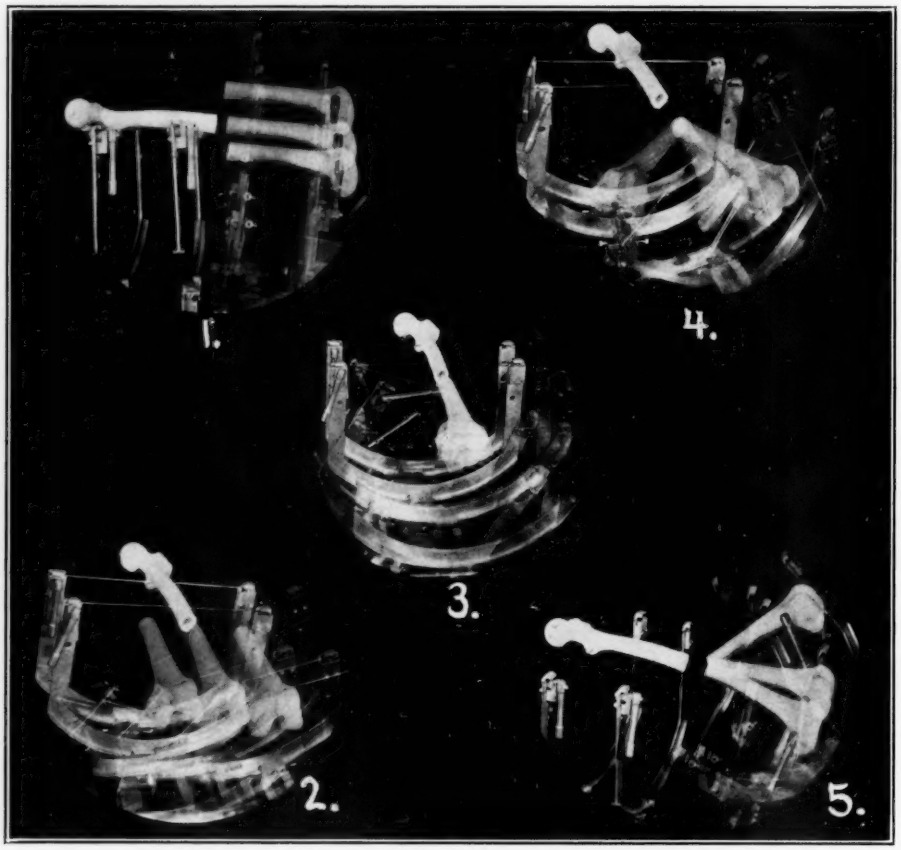

Fig. 6.—*1*, Vertical motion; *2*, lateral motion; *3*, axial rotation; *4*, horizontal pivotal motion; *5*, vertical pivotal motion.

APPARATUS

In accordance with the above principles, the apparatus presented is designed for the adequate suspension of the fragments of a broken or severed bone. The apparatus is capable of grasping multiple wires at any angle in space. It suspends the proximal fragment in a definite immovable position. The distal fragment is suspended by an undercarriage with a remotely controlled point of universal motion, which may be placed either at the distal end of the proximal fragment or at the proximal end of the distal fragment. This point of universal motion may thereby be adjusted in cubic space; that is, vertically, laterally,

and longitudinally. The undercarriage suspending the distal fragment is further capable of exerting traction. Thus, the distal fragment may be brought in line with the proximal fragment about a point of universal motion at the distal end of the proximal fragment or at the proximal end of the distal fragment. With this apparatus, therefore, a fracture may be reduced with the minimum amount of motion (and resulting trauma) at the site of fracture.

This is the main feature distinguishing the apparatus presented from all other fracture devices heretofore used.

Handles *A*, *B*, *C* (Fig. 5), respectively, combined afford universal point of motion at the desired point at the site of fracture. This point of universal motion may be adjusted vertically by *D*, laterally by *E*, and longitudinally by *F*. Knob *G* is for traction or lengthening; Clamp *H* with wire tensioning device *I* and *J*. *I* grips wire automatically if the wire is pulled in the direction of Handle *G*, which tenses wire by simply turning it in a counter-clockwise direction. The apparatus is 30 inches long, 24 inches wide, and 22 inches high. It weighs approximately 75 pounds. The dimensions have been chosen so that it may be used to treat a fracture of the femur as well as the smaller portions of either upper or lower extremity. Its main disadvantage is its height as it necessitates the additional use of an adjustable platform and pelvic rest for the patient. There are other unimportant minor disadvantages, but these readily may be overcome by slight changes in design.

CONCLUSION AND SUMMARY

A more detailed description of the apparatus and case reports will form the basis of a future publication. In addition there will be more detailed technical descriptions relative to bone lengthening and fractures in a more practical light. This paper, presented purely as a preliminary report, deals only with basic principles and presents a new apparatus.

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ARTIFICIAL SKIN-LINED ANTETHORACIC ESOPHAGUS FOR IMPERMEABLE STRICTURE

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THE conditions in which the construction of an artificial esophagus is indicated are so rare that very few cases have been reported. However, where these conditions do exist, this operation makes it possible for an individual who has been condemned to a life of more or less isolation because of inability to partake of food in the company of others to again take a place at the family table with its attendant sociability and to enjoy the actual taste of food. Surely this is a most desirable accomplishment and well worth the patience required of both patient and surgeon to bring this about.

The condition for which esophagoplasty is indicated is stricture of the esophagus. This may be benign or malignant. In the case of benign stricture most cases can be cured by gradual dilatation of the stricture and by keeping it dilated by periodic passing of bougies. It is only in those cases in which a stricture is absolutely impermeable or so extensive that it cannot be dilated that an esophagoplasty should be considered, and then only after every possible conservative method of cure has been tried, including direct and retrograde esophagoscopy, passing of filiform bougies, swallowing of string, etc. In the case of malignant stricture, only those cases should be considered in which the cancer has been removed and a recurrence is unlikely.

Thus the field for this operation is very limited, for most benign strictures can be dilated and thus far only a few cases have been reported in which a carcinoma of the esophagus has been successfully removed.

The various methods employed and their successes and failures have been very carefully described and the literature on the subject summarized by Ochsner and Owens in 1934.[1] In brief, they include an esophagostomy in the lower part of the neck, bringing the divided end of the esophagus proximal to the stricture to the surface of the body. In the case of a malignant stricture, this has already been done in the original operation for resection of the cancer. In cases in which the upper end of the esophagus is long enough, it may be brought farther down on the chest wall through a tunnel under the skin, as described in a case by Garlock.[3] This esophageal fistula is then connected to the stomach by one of the following methods: (1) Construction of a skin tube going down almost to a gastrostomy wound and

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connected with it by a short rubber tube; (2) using a segment of jejunum attached to the stomach at its lower end and its upper end (a) brought through a tunnel under the skin to the esophageal fistula or (b) to the lower end of a skin tube going up to the esophagus; (3) using a segment of the transverse colon in a similar way; (4) making a tube from the lesser curvature of the stomach, leaving it attached to the stomach at one end and bringing up the other end as in the case of the jejunal segment; (5) using the entire stomach as a tube and bringing it through a tunnel under the skin to the esophageal fistula.

Most of these procedures have been done in Europe and the mortality has ranged from 22 to 66 per cent, depending upon the method used. In this country one case has been reported by Ochsner for benign stricture in which he used the jejunodermatoesophagoplasty method, and one each by Eggers[2] and Garlock[3] for malignant stricture in which they used the rubber-tube dermatoesophagoplasty method. These patients all recovered and had good functional results. In the first case, six different stages were required and during part of the time the patient was in desperate condition. In the case of Eggers three stages were required and the procedures seemed less dangerous, while in the case of Garlock a short skin tube was connected to a low-lying esophageal fistula. Several other cases have been reported in which an upper esophagostomy was done for malignant disease lower down and the esophageal fistula joined to the gastrostomy wound by a rubber tube. This was first done by Torek in 1913[4] after a successful resection of a cancer of the esophagus.

We wish to report a second case, in which an artificial extrathoracic esophagus was constructed for benign stricture.

Mrs. H. C., aged 24 years, was first seen Dec. 5, 1927. Nine weeks previously she had burned her face and throat with a strong fluid. Since then she could only swallow fluids and very soft food and such swallowing was painful. Nothing abnormal could be seen in the pharynx, but a stomach tube did not pass more than 8 inches from the teeth. An x-ray examination showed an irregular constriction of the esophagus just above the aortic arch. The esophagus above this point was dilated to a width of about 1½ inches. A slight amount of barium trickled through the obstruction.

Attempts were made to pass bougies, but were not successful, and another x-ray taken a week later showed practically complete stricture. She was admitted to the Deaconess Hospital and on Dec. 20, 1927, a gastrostomy was done under local anesthesia by the method of Stamm. Convalescence was rather prolonged and further attempts to get through the stricture were not considered advisable until Feb. 23, 1928, when Dr. Morris Newman performed an esophagoscopy. This was repeated several times, both from above and below, but all attempts to get through the stricture were unsuccessful. A number of attempts to swallow a thread were also unsuccessful.

However, on April 17, 1928, a fine filiform bougie was finally passed through the stricture, followed by a long silver probe. During these manipulations, the patient developed a high temperature and they had to be stopped, although by this time

the patient could swallow liquids. By August, 1928, she could swallow fluids satisfactorily; the gastrostomy tube was removed and the wound allowed to heal.

In May, 1929, swallowing again became difficult, attempts at passing a probe were unsuccessful, and x-ray examination at this time showed complete obstruction (Fig. 1). She was readmitted to the hospital and on May 16, 1929, a second gastrostomy was performed by Dr. E. T. McGroder.

Following this, she became well nourished and felt fine, feeding herself entirely through the gastrostomy tube. At this time an artificial esophagus was proposed to her but refused.

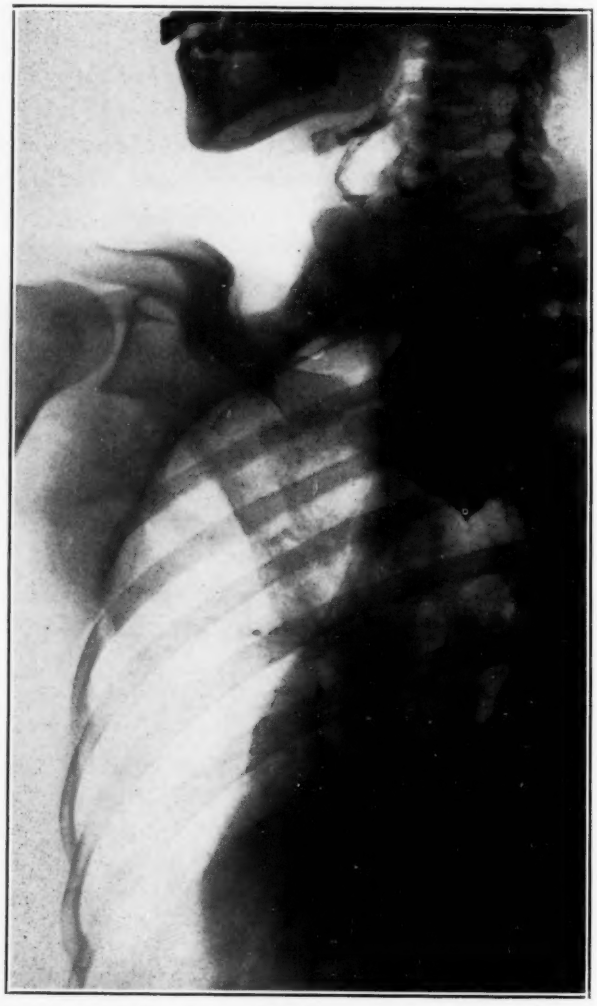

Fig. 1.—Roentgenogram taken May, 1929, showing complete obstruction and dilatation of esophagus above it.

In April, 1934, an appendectomy was done without any difficulty.

In March, 1938, the patient returned and said that she was tired of taking her food through her gastrostomy tube, that she was anxious to eat like other people, and that she was willing to submit to any procedures that would bring this about. Accordingly we admitted her to the hospital and proceeded to do the first stage.

First stage, esophagostomy, was performed March 19, 1938. An incision was made along the anterior border of the left sternomastoid muscle from the level of the

cricoid cartilage to the sternum. The sternomastoid muscle and carotid sheath were retracted laterally and the left ribbon muscles and lobe of the thyroid medially. A greatly dilated esophagus, about 2 inches in diameter, then came into view which was bluntly and quite easily separated from the trachea in front and the spinal column behind. The left recurrent nerve was visualized, running along the trachea, and was not injured.

After separating the esophagus from its adjacent structures and well down into the mediastinum, about 2 inches below the upper border of the sternum, a silk ligature was applied at the lowest possible point and a curved clamp about 1 inch above it. The esophagus was divided between the two and the stumps sterilized with tincture of iodine. The lower stump was allowed to drop into the mediastinum and two small iodoform tampons inserted down to the stump. The lower end of the upper

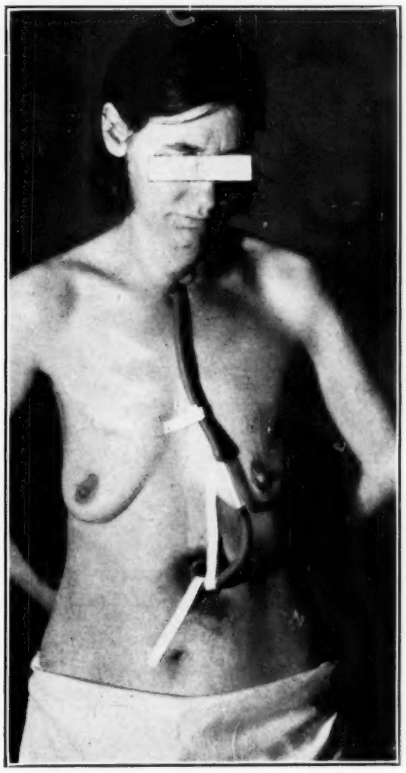

Fig. 2.—Esophagostomy completed and rubber tube connecting esophageal and gastric fistulas.

esophagus was then brought out to 1 inch beyond the skin edge and sewed to the lower end of the wound with interrupted chromegut sutures. The fascia was closed around the esophagus and tampons with interrupted chromegut and the skin with Michel clamps and a few silk sutures. The clamp at the end of the esophagus was replaced by a linen suture. Time of operation, one hour and fifteen minutes.

The postoperative course was quite mild, but the wound in the neck became infected and discharged a foul-smelling pus. Smears taken on April 6 and May 2 showed numerous spirella and a moderate number of fusiform bacilli. Four doses of 0.3 gm. neosalvarsan were given intravenously and the wound soon became clean. Patient left the hospital on May 7 with a tube connecting the esophageal fistula with the gastrostomy wound (Fig. 2).

Patient re-entered the hospital June 7, 1938. The wound in the neck was well healed and working properly.

Second stage, partial construction of antethoracic esophagus, was performed June 9, 1938. Two vertical incisions were made three inches apart on the front of the chest from the level just below the esophageal fistula to a level just above

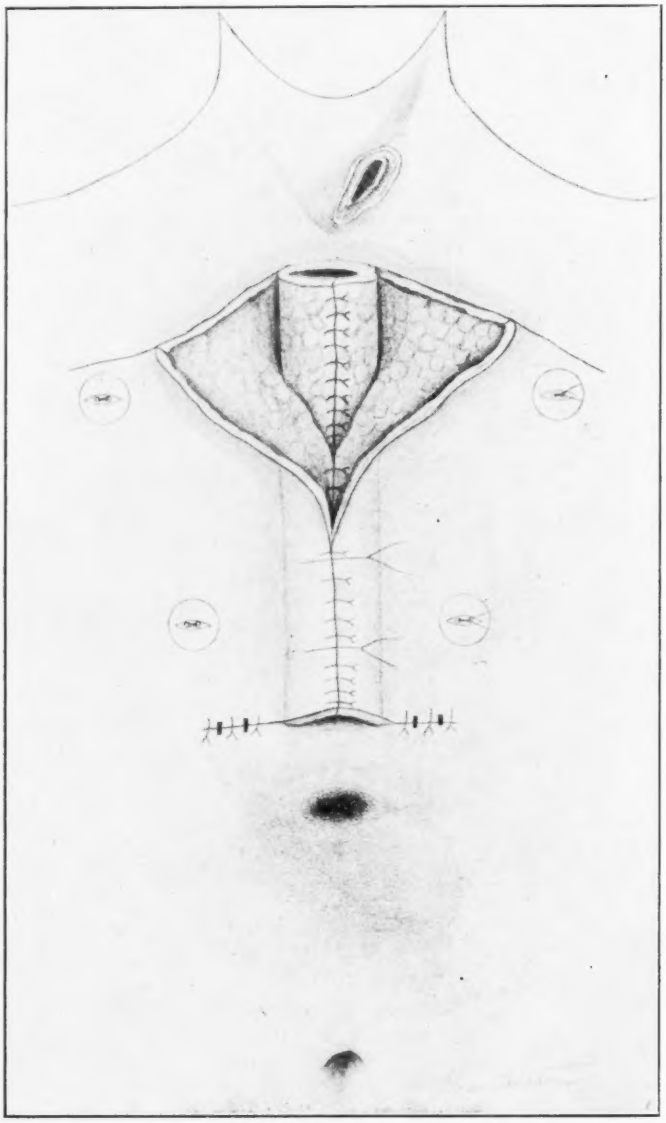

Fig. 3.—Formation of skin tube by inverting skin flaps and covering tube thus made with undermined skin flaps from each side. These were brought together by two tension sutures passing beneath skin tube and threaded on buttons on each side.

the gastric fistula. Transverse incisions were made toward the center at each end and skin and subcutaneous tissue were dissected on each side toward the center, leaving a broad base attached along the middle. The edges were brought together to form a skin-lined tube, sewing them together with one layer of interrupted fine chromic sutures going through the deeper layers of the skin and another similar layer through the subcutaneous tissue.

The skin on each side of this area was undermined and the edges were brought together over the new-formed tube by means of two tension sutures passing beneath the tube and through buttons on each side. The edges were then sutured with interrupted silk and a few silkworm-gut sutures. The transverse incisions which had been made at the ends of the vertical incisions were closed with clips and silk sutures. There was no difficulty in bringing the skin flaps over the new-formed tube. (Fig. 3.)

Fig. 4.—Artificial skin-lined esophagus along front of chest. Upper end connected to esophageal fistula and lower end to gastric fistula by means of rubber tubes.

While the wound of this operation healed primarily, convalescence was attended by a chill on the tenth day, followed by temperature of 104° F. and eventual formation of an abscess in the neck near the esophageal fistula. This was incised on July 12, with discharge of pus, but showing no bacteria on smears or growth on culture. The patient left the hospital on July 24 with all wounds healed and able to swallow liquids by connecting the upper end of the skin tube with the esophageal fistula and the lower end with the gastric fistula by means of short rubber tubes. (Fig. 4.)

On Sept. 15, 1938, patient re-entered hospital for the final stage.

Third stage, construction of additional skin tube to connect upper end with esophageal fistula, was performed Sept. 17, 1938. Two vertical incisions were made between the levels of the esophageal fistula and the upper end of the antethoracic esophagus, about three inches apart, and corresponding horizontal incisions were made toward the middle from the ends of the vertical ones, making two flaps, which were undermined and sewed together anteriorly by two rows of sutures as was

done in the second stage. An anastomosis of the lower end of this tube was made directly to the upper end of the previous one by two rows of chromic sutures, none of them piercing the skin. The upper end of the new tube was sewed to the skin around the esophageal fistula, so that the latter emptied into the new esophagus.

Horizontal incisions were made laterally at the upper and lower ends of the denuded area, the skin flaps undermined, two vertical relaxing incisions made lateral to them, and the flaps brought together over the new tube with considerable tension

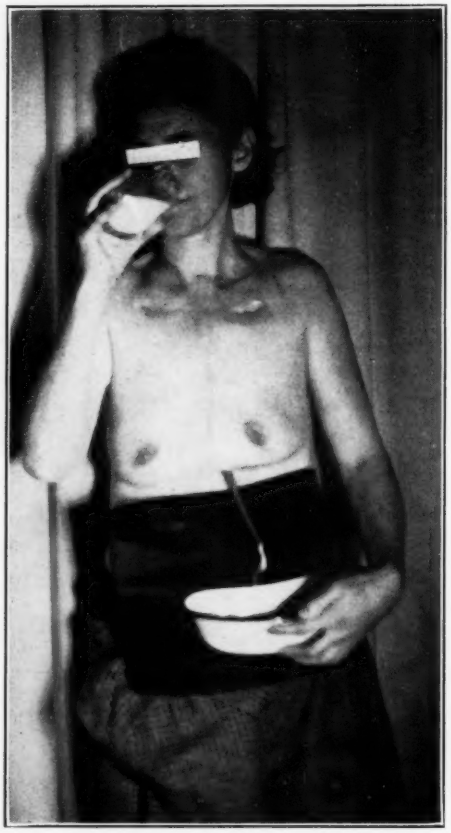

Fig. 5.

Fig. 6.

Fig. 5.—Artificial skin-lined esophagus completed almost down to level of gastric fistula. Tube inserted into lower end to show milk passing through.

Fig. 6.—Lower end of artificial esophagus connected to gastric fistula by means of rubber tube and patient able to drink and eat soft or well-masticated food in the normal manner.

and with some small bare areas. They were sewed together with interrupted silk sutures.

Convalescence from this stage was not as smooth as from the other stages. Due to the tension of the skin, large areas sloughed and very slowly healed by granulation. At the points of anastomosis, healing was perfect, but a fistula formed in the middle of the upper new-formed segment and discharged saliva and any fluid taken by mouth.

Patient finally left the hospital on Oct. 28 with all areas healed except this fistula ¾ inch in diameter and a bare area on chest 3 inches by 1 inch not yet covered by skin. By Feb. 15, 1939, all wounds were healed and the artificial esophagus

was intact from the mouth to its lower end just above the gastrostomy wound (Figs. 5 and 6).

However, our troubles were not yet over, for it was very difficult to fit a tube into the gastrostomy wound and the lower end of the esophagus that would not leak. Finally, a Pezzer type of tube was inserted into the stomach and held snugly by a collar pressed down on the outside of the wound and the other end was inserted into the lower esophagus without leakage. But after each meal, stomach contents regurgitated through the tube and irritated the skin in the esophagus. To correct this, a small screw clamp was placed on the rubber tube, by means of which the patient compresses the tube after each meal.

This is as far as we will proceed with this case, for it would probably be impossible to make a successful anastomosis of a skin tube with the gastrostomy wound because of the irritation of the skin from the gastric juice. Neither did we think any of the other methods mentioned in the beginning of this paper would be feasible, because of the adhesions following two gastrostomies and the irritated condition of the skin after more than ten years of a gastric fistula. Furthermore, we did not think the attempt justifiable in view of the high mortality of the other methods and the very satisfactory functioning of the present skin-rubber tube esophagus. It also makes it possible to supplement feeding through the esophagus with additional feeding directly into the stomach if necessary.

This patient is very happy with the result, and, even though she cannot swallow solid food, she has no difficulty in washing it down with fluids, after it is thoroughly masticated.

CONCLUSIONS

1. The making of an artificial extrathoracic esophagus has a very limited field; namely, (a) in cases of benign stricture that are absolutely impermeable by all known methods, and (b) in cases of malignant stricture in which the cancer has been successfully removed.

2. Where indicated, the making of an esophagostomy and a skin tube down the front of the chest is the simplest and safest method. The only disadvantage is the difficulty or impossibility of making a connection between the lower end and the gastric fistula, but this gap can be easily bridged by a short rubber tube.

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AN INQUIRY INTO THE FUNCTIONAL CAPACITY OF THE CECAL APPENDAGE IN REPRESENTATIVE BIRDS AND MAMMALS*

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IN A PRELIMINARY report (Wangensteen, Buirge, Dennis, and Ritchie, 1937) it was observed that the cecal appendage of the rabbit and the vermiform process (or appendix) of man exhibit a greater capacity for secretion than for absorption of fluid. This suggested that the rabbit might be a satisfactory animal for the investigation of the production of acute appendicitis by obstruction of the lumen and consequent rise in intraluminal pressure. Since the cecal appendage of the rabbit differs in certain essential structural respects from the vermiform appendix of man, anatomical and physiological studies were undertaken on a variety of available animals in an effort to find a species more closely resembling man. It then came to the attention of the authors that, although extensive comparative anatomical studies of the cecal region, such as those of Huntington (1903), Kelly and Hurdon (1911), and Reider (1936), have been made, no extensive studies of the comparative physiology of this region have been made. It, therefore, seemed highly relevant to the study of the etiology of appendicitis in man to make comparative studies on the secretory and absorptive function of this region in as many animals as are available and manageable in an experimental laboratory. It is hoped that the results of such a study will perhaps suggest a clue as to the far lower frequency of acute inflammation in these lower animals than obtains in man. The comparative anatomical studies mentioned above indicate that only in man, the chimpanzee, the gibbon, the gorilla, and the orangutan is a true vermiform appendix found; very similar structures in many respects, however, are to be found in the rabbit and the wombat. Throughout this paper, the term cecal pouch is considered synonymous with the word cecum. The term cecal appendage is reserved for the blind segment springing from the cecum in those species in which such a structure is found. (Fig. 1.)

METHODS

Surgery.—Strict aseptic surgical technique was observed throughout. The type of operation used was as follows: The abdomen was opened

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and the cecum delivered into the wound. In those animals in which no cecal appendage was present, the cecal pouch was used. A large bore cannula was tied into a puncture opening in the tip of the cecum or appendage, and the bowel wall was reflected further onto the cannula by means of a purse-string suture placed at a small distance around the first tie. A tie was placed loosely around the base of the appendage, or

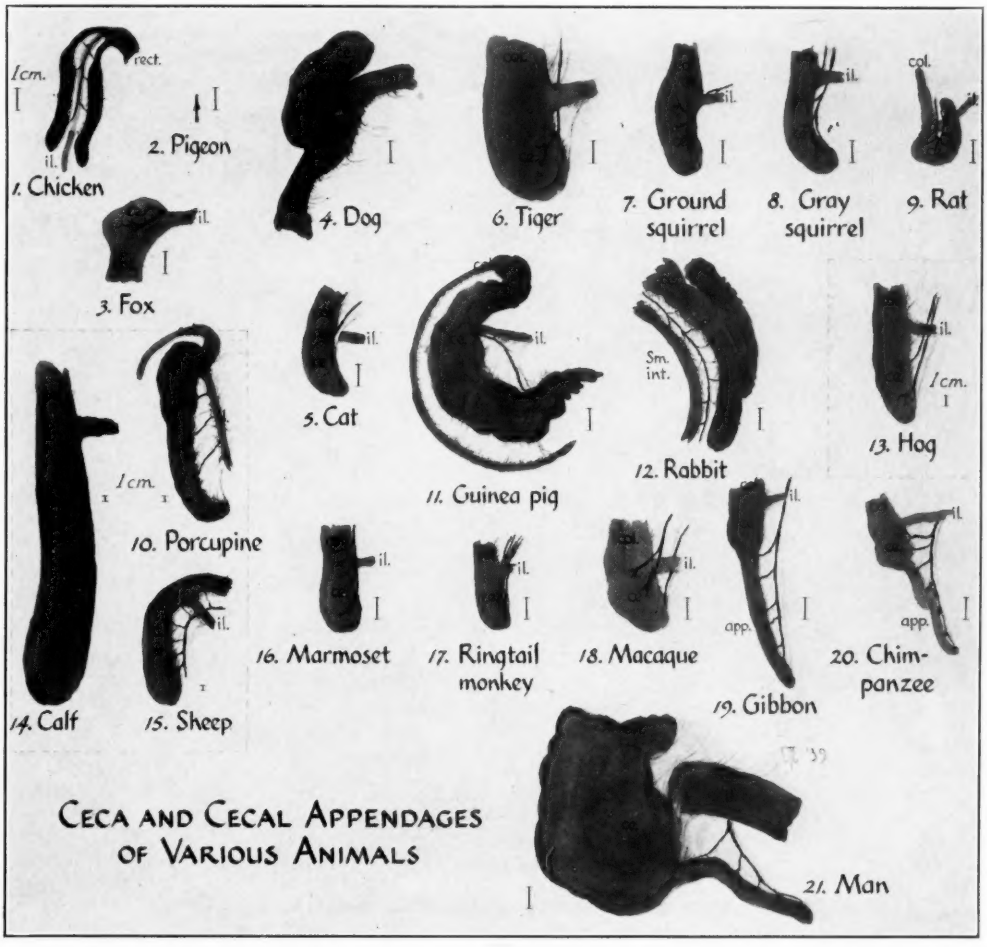


Fig. 1.—Outline drawings of the cecal appendages (or vermiform appendices) of the various animals studied. The scale of the drawings is indicated in each case by the fine vertical line beside it.

around the base of the cecal pouch in those species lacking a true appendage, and the lumen was washed with a small amount of sterile saline solution, or tap water. The loosely laid tie was now made tight, forming a closed loop of the appendage. The volume of this closed loop was determined at 10 or 20 cm. of water pressure. The abdominal wound was closed in layers with silk. In certain instances a small rubber balloon on a catheter was left in the abdomen for recording of

intra-abdominal pressure. A 7 cm. piece of rubber tubing (Dakin's tubing) from the cannula was led out through one end of the wound.

At the end of the experiment, the incision was opened and the cecum or appendage removed, the stump being inverted and the abdomen closed. Except for the sheep, calf, and tiger, the majority of the animals were saved. The freshly removed specimens were fixed in 4 per cent formaldehyde solution for microscopic study.

Recording.—Variations in the pressure within the appendage or cecum were determined by a recording mercury manometer of small bore such that the instrument plus the tubing (pressure tubing except through the wound and inside the abdomen) required the addition through the cannula of 1.1 c.c. of fluid to raise the reading 100 cm. of water* (Fig. 2). It was a simple procedure, therefore, to calculate the

Fig. 2.—Pressure recording of cecal pressure being made on the tiger.

pressure developed in the system as well as to determine how much fluid was added by secretion or removed by absorption. No increase in fluid in the external system was considered significant unless this increase was comparable to the measured amount of fluid initially left in the lumen.

In some of the animals studied, simple ligation of the base of the cecal pouch or appendage was performed, without incannulation of the tip. The abdomen was reopened after varying specified periods of

*In the experiments on the apes, monkeys, and the tiger a new manometer was used, which required the addition of 0.54 to 0.55 c.c. of fluid to raise the pressure from 0 to 100 cm. of water.

time for examination and amputation of the specimen. It was assumed that any organ which secreted a significant volume of fluid following obstruction would show noticeable changes in appearance. These experiments were used only as supplementary procedures except in the case of the pigeon, in which the pouches are too small for incannulation.

*Anesthesia.**—Amytal or pentobarbital was used for anesthesia. In the great majority of animals it was possible to inject the initial dose without preliminary medication, but with the bear, chimpanzee, tiger, etc., preliminary ether anesthesia was attained in a closed chamber after the method described by Fulton (1937).† The usual dosage of

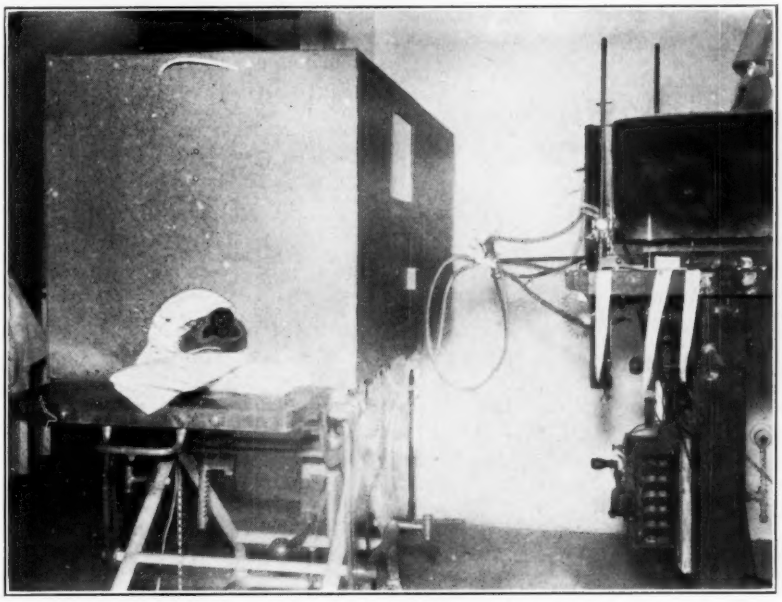


Fig. 3.—Arrangement of apparatus for the study of intraluminal pressure attending ligation of cecal appendages. The photograph shows a gibbon within a thermostatically controlled temperature box.

pentobarbital sodium was 35 mg. per kilogram of body weight; the dosage of amytal was somewhat larger.

Following the initial procedures, anesthesia was maintained at a depth just sufficient to prevent struggling. For this purpose amytal was usually injected subcutaneously by an electrically driven syringe, repeating the initial dose in the first six hours, after which the rate of injection could be slowed.

Care of the Animal While Under Anesthesia.—Except in a few of the earliest animals in which the temperature was not controlled, the rectal

*The possibility of anesthetizing animals by having them ingest meat into which pentobarbital sodium had been introduced was explored somewhat. Our experience would suggest this method as a feasible means of capturing large felines in the wild, provided the barbiturate is in shredded form and coated with phenyl salicylate.

†We wish to express our appreciation to Dr. John F. Fulton for his kindness in offering directions and information concerning the handling and anesthetization of the apes.

temperature of the animal was maintained between 37 and 39° C. by the use of a thermostatically controlled chamber kept at 29° C. (85° F.) (Fig. 3).

In order to prevent the development of pulmonary congestion and subsequent pneumonia, it was found necessary not only to control the temperature, but also to turn the animal from side to side every two to four hours. In addition, subcutaneous injections of solutions of 0.9 per cent sodium chloride alternated with 5 per cent glucose in distilled water were given twice daily in amount equal to 5 to 6 per cent of the body weight. In those animals in which it was possible, urine was collected and measured, and the specific gravity determined, the administration of fluid being governed according to these findings.

FINDINGS

The findings on twenty-six species studies are presented in the order in which these species were placed for us by Mr. Gustav Swanson.*

Fowl (Class Aves).—

Duck (*Anas platyrhynchos* Linne): Three mallard ducks were used. Examination two weeks after simple ligation in two of them showed the ligated cecum to be unchanged grossly, but on microscopic examination some thickening of the wall was evident, due chiefly to thickening of the mucosa. In the other of these birds a recording was made over a period of five and one-half hours; the pressure fell to 0 from 10 cm. of water in two hours, and the cecum was demonstrated to absorb 1.4 c.c. of fluid in the five and one-half hours. Microscopically no inflammation was demonstrable.

Goose (*Anser anser* [L.] is the ancestor): Four geese were used. Examination six weeks after simple ligation in two of them showed no significant gross changes except that the ligated ceca were smaller than the controls in each bird. Microscopically there was little difference. The other two birds were used for recordings. In one of them the picture was confused by the formation of considerable gas in the lumen, but the other showed definite evidence of fluid absorption in five hours. There was no change microscopically.

Chicken *(Gallus):* Eleven chickens were used.† Ten of these were subjected to simple ligation of one of the paired ceca without washing the lumen. All but three showed at the time of examination (varying from two hours to thirty-eight days) shrinkage and thickening of the wall of the ligated cecum; in the case of the three exceptions the ceca were filled with feces, gas, and some fluid, in no case with fluid alone. These specimens showed no evidence of acute inflammation among the six which were examined microscopically, with one exception; this

*We wish to express our appreciation to Mr. Gustav Swanson, Assistant Professor of Economic Zoology, University Farm, University of Minnesota, St. Paul, Minn., for his kindness in supplying the classification of most of the species studied.

†To Dr. Benjamin Pomeroy, Instructor in Veterinary Medicine at the University of Minnesota, who helped with the experiments in the fowl, we acknowledge helpful assistance.

was a shrunken specimen, forty-eight hours after ligation, and probably due to manipulative trauma such as Wangensteen and Bowers (1937) showed could be produced in the dog. A record was run on the last chicken for two hours, and no evidence of secretion was found.

Pigeon (*Columba livia* Gmelin): Since the paired ceca of the pigeon are too small for incannulation, measuring 1 by 2 mm., both ceca of two birds were ligated with fine silk. One was sacrificed two weeks later and showed slight enlargement on both sides; the other was sacrificed seven months later, when one cecum was a mere pinpoint, and the other was twice normal diameter. Whether or not these changes might be due to increase in quantity of fluid is very questionable. Microscopic examination of the enlarged ceca showed the mucosa and lymphoid tissues thinned to two to three layers of cells. No polymorphonuclear cells were seen.

Class Mammalia, Order carnivora.—

Dog (*Canis familiaris* L.): Two of the four dogs used were subjected to simple ligation of the base of the cecal pouch. In one of these the lumen was washed prior to ligation, using an enterostomy tube inserted through the opposite wall of the large bowel. On the ninth day relaparotomy was done; there was a mass of adhesions about the cecal pouch, and the enterostomy wound was clean and well healed. The pouch was contracted, with the wall thickened, adhesions covered the serosa, and thick fluid was found in the lumen. There was no evidence of rupture. Microscopic examination showed a normal cecum except for traumatic serositis. In the other experiment in which simple ligation was done, washing was not carried out. On the tenth day relaparotomy showed a contracted cecal pouch with many adhesions, the lumen containing thick mucoid material. Again there was no evidence of rupture. Here also microscopic examination showed only a traumatic serositis. Evidently there had been no fecal matter in the cecum at the time of ligation. These findings therefore confirm those of Wangensteen and Bowers (1937), who found that ligation of a clean cecum in the dog resulted in no untoward developments (although the presence of feces in the lumen at the time of ligation resulted in the development of acute inflammation).

In the remaining two dogs recordings were made. Calculations showed that in one dog the cecum absorbed 17 c.c. of fluid in five hours, and in the other it absorbed 6 to 7 c.c. in the same time, the pressure tending to fall to about 3 to 6 cm. of water. In the first dog the pressures were maintained at about 25 cm. of water; in this case the microscopic examination showed very few polymorphonuclear leucocytes in the muscle, none in the mucosa. In the second animal the pressures were kept between the intra-abdominal level of 4 cm. and 10 cm.; here the microscopic examination showed no evidence of inflammation at all.

Red Fox* (*Vulpes fulva* [Desmarest]): Opportunity was offered to work on five red foxes. The cecal pouch of the fox is supplied with blood through vessels in a very fine veil which binds it closely to the ileum, as indicated in Fig. 1. This arrangement resulted in the loss of two foxes after attempts at simple ligation of the base of the cecum without recordings. In each of these cases there was gangrene of the whole cecum. A third attempt was successful. The cecum was re-examined thirteen days later and appeared grossly and microscopically normal.

Pressure tracings were made on the other two animals. Each of these experiments ran for seven hours, and each failed to show any evidence of fluid formation within the lumen of the cecum; one cecum was found flaccid and empty, the other almost empty, but edematous. In the first, microscopic examination showed no serosal reaction, very occasional polymorphonuclears in the muscle, and intact mucosa; in the second the findings were similar, but without polymorphonuclears at all. The muscle is very thin in this species, with abundant mucosa and villi.

Raccoon (*Procyon lotor* [L.]): Two raccoons were loaned to us. Laparotomy on one of them showed the same situation as obtains in the skunk and the bear, no evidence of ileocecal valve or cecum being present. In the raccoon a thickening of the wall of the bowel was present in about the site where the ileocecal valve would be expected in many other species; this suggested a muscular sphincter. The wall of the bowel below this point was thicker than that of the ileum, and the surface was finely corrugated. No sections were taken.

Minnesota Black Bear (*Euarctos americanus* [Pallas]):† A 210-pound, 2-year-old black bear was loaned to us. Laparotomy showed the bowel to continue without interruption from jejunum to rectum, without ileocecal valve. Although there was no definite division between the ileum and the colon, on progression down the intestine, there was a definite change of color with some gradual thinning of the walls, and with some definitely visible strands of longitudinal muscle below the point at which the ileocecal valve would be expected in many species.

Skunk (*Mephitis mephitis hudsonica* [Richardson]): Three skunks were presented to one of us. Their estimated ages were 2 to 3 weeks, and their weight about 500 gm. each. Laparotomy was performed on one of them and the bowel was found to be continuous from duodenum to rectum without any semblance of either ileocecal valve or cecum. All three of these animals were fed hamburger and cod-liver oil, and all three

*We wish to thank Dr. R. G. Green, Professor of Bacteriology, University of Minnesota, for placing these animals at our disposal.

†The experiments on the bear, the tiger, the marmoset, the ring-tailed monkey, two of the macaques, one of the gibbons, and the three chimpanzees were done at the Como Park Zoo of the City of St. Paul. We wish to express our gratitude to Mr. Fred M. Truax, Commissioner of Parks, Playgrounds, and Public Buildings, and to his staff for their invaluable help in the handling of these animals and for the excellent facilities provided.

of them died of spontaneous multiple intussusceptions which recurred in each case even after reduction with enemas, after suspension of the apex to the anterior abdominal wall during operative reduction, etc. Two of the skunks had more than one area of intussusception at post-mortem examination.

More recently an opportunity was offered to do post-mortem examinations on two more skunks, one adult and one 3 weeks old. These had been fed a more varied diet, containing large quantities of insects, and in neither of them was any evidence of intussusception found. The younger one had been shot with a rifle; the older had died of a pelvic abscess.

Cat (*Felis domestica* Fischer): Three cats were used. In the first of these simple ligation was performed, after unsuccessful attempts to irrigate the lumen. The cecum was removed two days later; at this time it was contracted and there was an area of necrosis in the wall opposite the mesentery. Microscopic examination showed acute inflammation. There was no evidence of secretion. Inflammation was attributed to trauma.

Records were made on the other two cats, the cannula being inserted in each case through the wall of the colon above the ileocecal valve, leakage being prevented by a purse-string suture; the cannula was led down the lumen into the cecum, the neck of which was tied tightly about a constriction near the tip. In the first cat the recording ran for eight hours; there was fermentation in the material in the cannula producing a rise in pressure recording, but the tip was found completely plugged at the end of the experiment, and the cecum was completely empty; whereas, 0.3 c.c. had been left within the lumen at the start of the experiment. In the second experiment the pressure remained at about the intraperitoneal level throughout, the lumen being empty at the end. In neither case was there microscopic evidence of inflammation except that in the first animal a small nest of polymorphonuclear leucocytes was found in one place in the muscle, presumably due to trauma.

Tiger (*Felis tigris* Linne): A senile, edentulous, failing, 182-pound tigress was offered to the authors for disposal, and recordings were made upon this animal. The cecum was found to have no tenia, and the pouch measured only 4 by 4 cm. After ligation of the base and incannulation, the volume was 2.5 c.c. The record was run for thirteen hours; the intraluminal pressure fell consistently to about minus 8 cm. of water in spite of a steadily rising intraperitoneal pressure which was recognized within four hours as being due to acute gastric dilatation. Attempts were made repeatedly to pass a gastric tube, but the cardia could not be passed; in addition the esophagus was too long for the stomach to be reached by hand. The intra-abdominal pressure terminally reached 22 cm. of water. No evidence, grossly or micro-

scopically, was found of inflammation on post-mortem examination. There was considerable lymphoid tissue present.

Class Mammalia, Order Rodentia.—

Rabbit (*Oryctolagus cuniculus* [L.]): The rabbit was the first experimental animal studied from the point of view of appendical secretion. Inasmuch as a special and more complete report on the behavior of the rabbit appendage is to be made in the near future, details are omitted here. The appendage of the rabbit secretes 20 to 50 c.c. of fluid daily, and ligation at the base under varying circumstances has been found to lead to the production of all grades of acute inflammation, including gangrene and perforation.

Gray Squirrel (*Sciurus carolinensis* Gmelin): Three gray squirrels were caught and used for recordings. In all three the pressure consistently fell to about 4 cm. of water, and the calculated amounts of fluid absorbed were 2.4, 0.8, and 1.8 c.c. respectively in six, six and one-half, and five hours, respectively. (The details of calculations are illustrated in the discussion on the rat.) No evidence of inflammation was found in any of the specimens. There was very little lymphoid tissue present.

Striped Gopher (properly Ground Squirrel) (*Citellus tridecemlineatus* [Mitchill]): Four native striped gophers were caught and used. Two of them were subjected to simple ligation of the cecal pouch. One of these was found half eaten in the cage one week later; the abdomen showed no sign of inflammation and section of the appendage showed only autolysis. The surviving animal lasted until sacrificed five months later, when the cecum was found communicating with the pouch, and no sign of the suture could be found. Recordings were made with the other two animals. In one the initial volume was 0.4 c.c., and in the other it was 0.8; both were almost entirely empty six and one-half hours later when they were sacrificed; the pressure in each case had remained at 2 cm. of water throughout the experiment except for small respiratory waves and some rhythmic contractions. On microscopic examination of the pouch no lymphoid tissue was found and there were occasional polymorphonuclear leucocytes in the mucosa, which had deep folds and large vacuolated cells. There were no polymorphonuclear cells in the muscle, but there was a serosal reaction. These minimal changes were attributed to trauma.

Albino Rat (*Rattus norvegicus* [Erxleben]): Seven albino rats were used. In four of these simple ligation of the base of the cecal pouch was performed. Two of these survived for three months, and then died, unfortunately escaping post-mortem examination. Two others were examined after being sacrificed four months after ligation. In one the tie was still present, but continuity of the lumen had been established through it, evidently by thinning of the cecal wall. The pouch was enlarged, now measuring 5 cm. in length, as compared to 2 cm. at the

time of ligation. In the other rat the tie was still present also, and the lumen was still obstructed, but a new opening had formed around the tie into the large intestine.

In the other three rats recordings were made of pressure variations. It was found that with the experiments started at 0 pressure in each case, the level rose in a short time to 7 or 8 cm. of water; removal of fluid at this point was consistently followed by a second rise in pressure, etc. The most convincing of these experiments is summarized as follows:

The initial procedures were carried out as described under "Method."

TIME (MIN.)	PRESSURE REACHED (CM. WATER)	VOLUME REMOVED (C.C.)	PRESSURE AFTER REMOVAL
0	2.5	0.4	1.0
49	5.0	0.6	1.0
93	4.0	0.6	0
126	2.0	0.2	1.0
183	4.5	0.4	0
244	5.0	0.3	-1.0
334	3.0	0.4	1.0
391	3.0	0.3	0

During this period there were waves every 20 to 40 seconds, lasting 10 seconds, rising from 2 to 7 cm., and returning approximately to the base line; these became less prominent as time passed. At the conclusion the animal was examined, and the appendage found to contain 1.8 c.c. The total amount of fluid removed was 3.2 c.c.; the sum of this and the amount in the appendage at the end minus the maximum amount which could have been present at the start (1.7 c.c.) is 3.3 c.c., the amount which must have been produced by the cecal pouch during these six and one-half hours.

Therefore the cecum of this rat secreted, or at least transferred fluid into the lumen during this experiment, although the pressure could not be so raised above 5 cm. of water. The only consistent finding microscopically was edema of the pouch wall except that one specimen showed a very few polymorphonuclear leucocytes in the wall. In this animal the pressure did not rise above 5 cm. of water. Inasmuch as a sustained pressure of 8 cm. was found sufficient by Wangensteen and Bowers (1937) to produce inflammatory changes in the cecum of the dog, the changes in this pouch in the rat might conceivably be due to this degree of sustained pressure.

Canada Porcupine (*Erethizon dorsatum* [L.]): One porcupine was obtained. A record was run for six hours. The cecal pouch was about 24 cm. long and contained about 55 c.c. of fluid and liquid stool when first exposed. The cecal pouch in this species resembles the entire cecum of the rabbit in many respects, but there is, of course, no cecal appendage. The record was started with 5 c.c. in the pouch, and 10 c.c. was added during the experiment, at the end of which the pouch contained only 1.6 gm. of material of a very thick consistency. The pressure remained around 6 to 7 cm. of water throughout the five and one-half hours; this probably was the intraperitoneal pressure. Micro-

scopic examination showed some hemorrhage into the mucosa, but no polymorphonuclear invasion.

Guinea Pig (*Cavia aperea* Pallas): Simple ligation of the cecal pouch was done on four guinea pigs, and they were sacrificed at intervals from two days to six weeks. The one examined in two days showed the cecum swelled to four times normal size and contained gas and fluid in about equal volumes; microscopic examination showed no inflammatory changes. Those allowed to remain for longer periods showed no microscopic reaction; in two of them, however, the lumen had become re-established around the ligature.

Pressure recording was made on two animals. The cecum of the guinea pig is about 15 cm. long, and the stomas of the ileum and of the colon are slightly separated. In the first animal the distal half only was isolated for study; in the second the entire cecum was used by dividing both colon and ileum near the cecum, and inserting the cannula through the lumen of the colon. In the first animal the pressure remained at the intraperitoneal level and at least half the isotonic sodium chloride solution left at the start was absorbed in four hours, there being only 2 gm. of thick fecal material present at the end. In the second animal sodium chloride solution also was definitely absorbed in two hours. In neither case was there microscopic evidence of inflammation.

Class Mammalia, Order Artiodactyla.—

Common Hog (*Sus scrofa* Linne): Experiments were performed on three young hogs weighing about 50 pounds each. Examination of one of these twelve days after simple ligation showed the pouch only loosely distended with gas and fluid, and microscopically normal.

In the other two hogs records were made for five and one-half and ten hours respectively. Both experiments showed absorption in excess of 25 c.c. per four hours. Microscopic examination in the first of these two ceca showed no change; in the second there was a moderate serosal reaction (trauma).

Sheep (*Ovis aries* Linne): Four sheep were used; all of them ultimately died from pneumonia despite precautions, except for the first which died of acute dilatation of the stomach incident to tying it down on its back. In the remainder of the animals, therefore, it was found necessary to tie the animal on the table on the chest, with the four legs extending off the edges, except that a sandbag was placed under the right groin. Even in this position, dilatation of the stomach occurred so rapidly that suction applied to an inlying large stomach tube was necessary to prevent gastric dilatation. In the first of the three animals from which any information was obtained, simple ligation was performed through a flank incision. The animal died a week later, and unfortunately was not examined until the following morning when the cecum was filled with gas, but contained no fluid. In

the second sheep a record was run for four hours; there was no rise in pressure and the cecum was entirely empty at the end of this period. In the last animal the record was started with 200 c.c. of fluid in the cecum; there were definite peristaltic waves and rhythmic contractions registered on the smoked drum, and the pressure gradually fell. Microscopic examination showed rather marked serosal reaction, but was otherwise essentially normal except for an area of hemorrhage and polymorphonuclear invasion in the basal layer of the mucosa, questionably due to trauma.

Calf (*Bos primigenius* Linne is the ancestor): One calf was used, weighing 75 pounds. The same methods of handling the animal to prevent acute dilatation of the stomach were used as have already been described for the sheep. The cecal pouch in the calf was large and had a capacity of 75 c.c. After addition of fluid to the system, the pressure consistently fell to 0 in a matter of minutes, and the total amount of fluid absorbed in five and one-half hours was 71 c.c. The cecum was removed at the end of this time and looked grossly normal, but on microscopic examination there was a heavy infiltration of all the layers of the wall with polymorphonuclear leucocytes, which it seems most rational to explain as due to difficulty encountered in keeping the cannula open, with consequent excessive manipulation of the tissue.

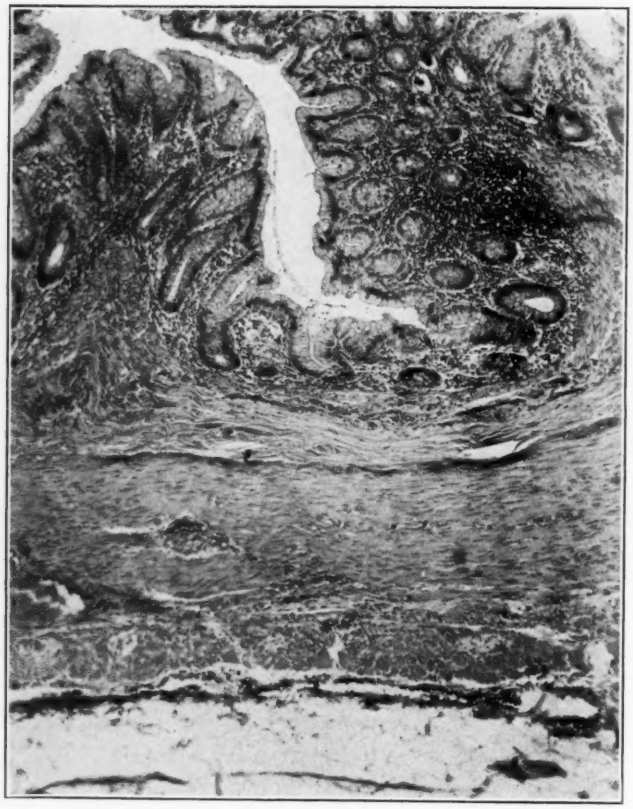
Class Mallalia, Order Primates.—

Marmoset (*Hapale albicollis* [Flower and Lydekker, 1891]): Records were made over a period of twenty-five hours on a 12.5-ounce marmoset monkey. There is no true appendage in this species, but the cecal pouch is 3 cm. long and about 1.5 cm. in diameter. The pressure rose to 5 cm. in the first four hours, and then slowly fell to 0, where it stayed throughout the remainder of the experiment. The pouch was almost empty at the end of the experiment. No evidence of inflammation was found grossly or microscopically at reoperation.

Ring-Tailed Brown Monkey (*Cebus capucinus* [L.]): A 5-pound ring-tailed monkey was used for recordings for forty-one hours, during which the pressure in the cecal pouch did not rise more than 5 cm. above the intraperitoneal pressure. The pouch was 2.5 cm. long and 1.3 cm. in diameter, and after ligation of the base and incannulation had a volume of 0.6 c.c. The lack of either active absorption or secretion of fluid, at least as indicated by fluid balance as determined in this experiment, is of interest because of the very rich blood supply to the cecal pouch. No evidence of inflammation was found on removal of the pouch, either grossly or microscopically. No lymphoid tissue could be found on sections.

Macaque (*Macacus rhesus* [Desmarest]): Experiments were run on four common macaque monkeys and one of the giant variety. Three of these were early experiments on animals heavily infected with tuberculosis in which the precaution of observing and recording the

A.



B.

Fig. 4.—*A*, Photograph of the cecum and vermiform appendix of the gibbon taken at laparotomy. *B*, Photomicrograph (magnification ×65) of the appendix of the gibbon twenty-two hours after ligature. The highest pressure attained was 19 cm. of water and it was sustained for a short time only. There is no evidence of leucocytic invasion of the walls. Histologically the appendix may be described as normal save for serositis due to trauma.

intraperitoneal pressure by means of a balloon left in the abdomen was not taken, and the misleading impression was gained that the cecum secreted up to a pressure of 12 cm. of water in eight hours or less. Because of recognition of these faults in technique and because of the short interval of time over which these recordings were made, two experiments were run at a later date with the necessary precautions. Each of these recordings extended over a forty-seven-hour period, and in each of them the intraluminal pressure fell to from minus 2 to plus 2 cm. of water, while the intraperitoneal pressure remained in the range from plus 8 to plus 12 cm. of water. In each case the cecum was found entirely empty at the conclusion of the recording. In one case the intraluminal pressure was never more than 1 cm. above

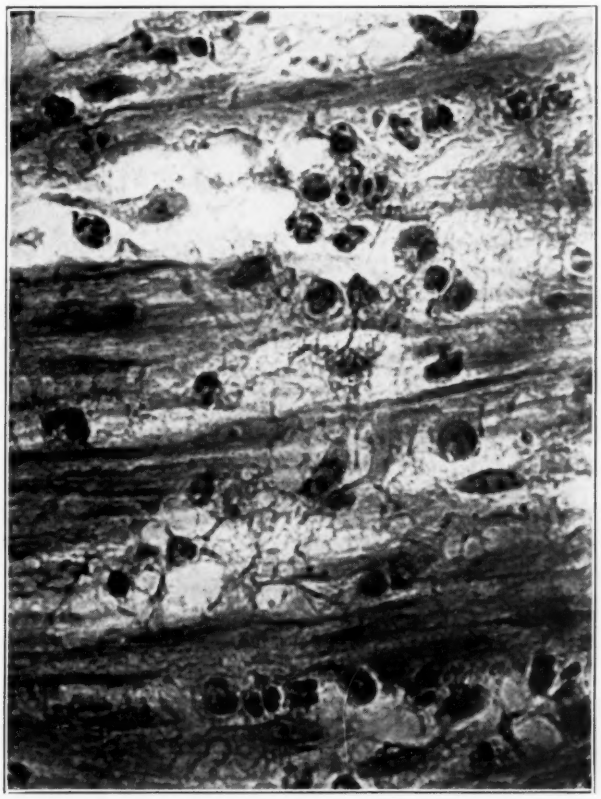


Fig. 5.—Polymorphonuclear invasion of the muscle wall of the chimpanzee vermiform appendix attending ligature of its base. The highest pressure reached was 106 cm. of water. The appendix perforated thirty-nine hours after the recording was begun, at which time the appendix was removed (magnification ×550).

the intraperitoneal; in the other it was higher by 9 cm. at nine hours, and remained below thereafter. In all probability this preliminary rise contributed to the erroneous deduction following the first three experiments. Microscopic examination showed plentiful lymphoid tissue, and in one specimen an occasional polymorphonuclear leucocyte.

Howling Golden Gibbon (*Hylobates entelloides* [Flower and Lydekker, 1891]): In two gibbons it was found that initially sufficient fluid

appeared in the lumen to raise the pressure to 19 cm. of water, but the rise in each case was transitory, falling in a few hours to the intraperitoneal level and remaining there. Microscopic sections made at the conclusion of these experiments were normal (Fig. 4). A more detailed account is being reported elsewhere (Wangensteen and Dennis, 1940).

Chimpanzee (*Pan* [*Anthropopithecus*] *troglodytes* [Gm.]): Records were made upon three chimpanzees, and it was found that the appendix in this species secretes fluid to pressures in excess of 100 cm. of water, and that the microscopic picture of acute appendicitis can be produced in this fashion, together with rupture of the appendix (Fig. 5). The details of these experiments are omitted here because they are being reported elsewhere (Wangensteen and Dennis, 1940).

Man (*Homo sapiens* Linne): Opportunity has presented itself in several instances of patients with cancer of the large bowel to carry out much the same procedure as was used in the apes. These findings will not be reported here as they are being dealt with at length in a separate paper (Wangensteen and Dennis, 1939). Suffice it to say that the appendix of man was found to secrete in the majority of cases from 1 to 3 c.c. of fluid daily, and that this organ is capable of building up a pressure sometimes as high as 90 per cent of the systolic blood pressure, with resultant clinical and microscopic signs of acute appendicitis, with immediate remission upon releasing the pressure.

SUMMARY

Experiments have been reported with reference to the functional behavior of the cecal appendage, or cecum in those species in which there is no cecal appendage, on the duck, the goose, the chicken, the pigeon, the dog, the fox, the raccoon, the bear, the skunk, the cat, the tiger, the rabbit, the squirrel, the ground squirrel, the rat, the porcupine, the guinea pig, the hog, the sheep, the calf, the marmoset, the ring-tailed monkey, the macaque, the gibbon, the chimpanzee, and finally man. A comparative study has been made of the function of the cecal pouch or cecal appendage as regards the balance in favor of secretion or of absorption of fluid. In this group of animals only man, the rabbit, and the chimpanzee showed positive evidence of fluid production in the cecal region; in the rat there was a rather delicate balance between absorption and secretion, the pressure being raised only 1 to 2 cm. of water above the intra-abdominal pressure, and not high enough to produce evidences of inflammation.

As shown in Table I, the only animals found to bear a definite fluid secreting area capable of raising intraluminal pressures to any degree were those with a cecal appendage, or appendix, arising from the cecum proper, and distinct from it, and it was this appendix which was found to secrete fluid in excess of absorption. In one animal with an appendix, the gibbon, no such secretion was found. The ceca to

which these appendices are attached are traditionally considered fluid-absorbing areas. In no case in the cecum itself as studied in the present experiments was secretion found to be significantly in excess of absorption. In only one animal with a cecal appendage was the cecum also investigated, the rabbit; here active absorption was observed, as will be reported elsewhere (Dennis, Buirge, Varco, and Wangensteen, 1940).

No regular relation was found between the amount of lymphoid tissue and the amount of secretion in the diverse species. In the tissues studied, it was found that gross and microscopic evidence of acute inflammation could be produced either by increase in pressure and distention (Bowers, 1937) or by trauma due to rough handling of the tissue.

A summary of the findings in this study is most conveniently given in Table I.

TABLE I

ANIMAL	CECUM PRESENT	CECAL APPENDAGE	SECRETION*
Duck	Yes	No	-
Goose	Yes	No	-
Chicken	Yes	No	-
Pigeon	Yes	No	?†
Dog	Yes	No	-
Fox	Yes	No	-
Raccoon	No	No	
Bear	No	No	
Skunk	No	No	
Cat	Yes	No	-
Tiger	Yes	No	-
Rabbit	Yes	Yes	+
Squirrel	Yes	No	-
Ground squirrel	Yes	No	-
Rat	Yes	No	Very slight
Porcupine	Yes	No	-
Hog	Yes	No	-
Sheep	Yes	No	-
Calf	Yes	No	-
Marmoset	Yes	No	-
Ring-tailed monkey	Yes	No	-
Macaque	Yes	No	-
Gibbon	Yes	Yes	-
Chimpanzee	Yes	Yes	+
Man	Yes	Yes	+

*-, Absent; +, present.

†The functional capacity of the cecum of the pigeon was not thoroughly explored because the ceca are too small for incannulation.

CONCLUSION

Among the group of animals studied, the only ones suitable for the study of the etiology of acute appendicitis from the point of view of the

obstructive mechanism are the rabbit, the chimpanzee, and man himself. With the exception of certain cases in which excessive trauma was involved, microscopic evidence of acute inflammation of the organ studied failed to occur except in the presence of increase in intraluminal pressure, and hence it is again suggested that increase in pressure, secondary (in clinical cases in man) to obstruction of the lumen, is probably an important factor in the production of acute appendicitis.

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RENAL VENIPUNCTURE: A METHOD OF EXPLANTATION OF THE KIDNEY FOR VENIPUNCTURE IN DOGS

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METHODS of subcutaneously explanting the kidneys in dogs to allow repeated renal venipuncture in the intact, unanesthetized subject have been described by Rhoads (1934), Sheehan (1936), and Gorden, Alving, Kretzschmar, and Alpert (1937). The methods adopted by Sheehan and by Gorden, Alving, Kretzschmar, and Alpert differ from that of Rhoads in that they aim at isolation of the renal vein in a skin bridge to prevent contamination of the renal venous sample by accidental puncture of the renal artery or ureter. Priority in renal explantation is claimed by Allen who refers to an introductory paper (1925) in which he mentions: "The transplantation of kidneys under the skin in a manner which has long been familiar with portions of the pancreas has proved valuable; the kidneys function satisfactorily in the new location, and all sorts of manipulation and the removal of portions for microscopic study are thus readily performed without important disturbance."

The method here described is relatively simple to perform, the wound heals rapidly, and puncture of the renal vein is not difficult, as the approximate position of the vein is indicated by the single line of scar. The operative wound has no complex lines of tension and wound necrosis has never occurred. The resultant absence of massive tender scar permits venous sampling without injury or contamination. It has therefore not been found necessary to isolate the renal vein.

Animals thus prepared may be used for the determination of renal blood flow or oxygen consumption (Van Slyke, Rhoads, Hiller and Alving, 1934) or in problems of altered renal hemodynamics (Corcoran and Page, 1939) or metabolism.

METHOD

The animals chosen were mongrel dogs of 12 to 16 kg. body weight. Docile dogs of the hound type with long, lean flanks were preferred.

Under amytal (iso-amyl ethyl barbituric acid, Lilly) anesthesia, an incision was made parallel and 5 cm. from the spine, beginning 3 cm. below the last rib. The abdominal muscles were split and the kidney delivered through the opening. The hilus and vessels were then freed of fat. A pocket was made caudally under the skin into which the kidney was then inserted. Two silk stay sutures were placed between

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the abdominal muscles and the tough subcutaneous tissue to fasten the kidney with its upper pole at right angles to the spine.

A gutter was prepared for the renal vessels and ureter by suturing the abdominal muscles flush to the subcutaneous tissues of one edge of the wound (Fig. 1). The muscles of the opposite side were sutured to the subcutaneous tissue about 3 cm. from the edge of the wound, leaving the skin flap free to cover the open trough. The renal vessels and ureter should lie freely within this groove with the kidney in position. The renal vein should be uppermost.

The skin over the kidney was then closed by a subcutaneous stitch which did not include the gutter (Fig. 1). The skin edges were then closed by continuous fine silk suture. A large cotton dressing was applied and held in place with collodion and bandage.

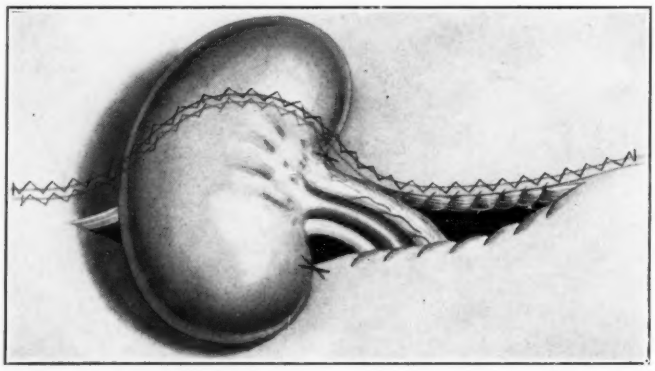

Fig. 1.—The sketch is drawn as if the skin were transparent. The line of cutaneous suture indicates the position of the skin edges. The muscular trough and the suture lines which form it are shown. The usual relative positions of renal vein, artery, and ureter are indicated, the renal vein being central and overlying the artery below and ureter above.

The dressing is taken off on the third or fourth day after operation and the continuous silk skin suture removed on the following day. Should there be evidence of wound infection or delayed healing, the sutures are removed and the wound dressed with cod liver oil, applied liberally to a large cotton dressing daily for three or four days.

A note and sketch are made at operation of the presence of anomalous positions of the renal vessels or ureter. The position of the most accessible portion of the vein is recorded with reference to the line of cutaneous suture. This position is confirmed by venipuncture when the wound has healed. It may then be indicated by the injection of a drop of India ink intradermally over the site.

SUMMARY

A method of subcutaneously explanting the kidney in dogs to render the renal vein accessible to venipuncture is described. It consists essentially in fashioning a subcutaneous muscular gutter in which renal vessels and ureter lie freely. The position of the renal vein is indi-

cated by reference to the single line of scar. The operation has the advantages that it is relatively easy to perform and that, with reasonable care, no failures occur.

The writers wish to thank Mr. R. J. Parker for technical assistance and to express their gratitude to the John and Mary R. Markle Foundation for financial assistance.

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COMPLETE RECOVERY FROM SERIOUS VASCULAR IMPAIRMENT FOLLOWING REMOVAL OF CERVICAL RIB*

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SYMPTOMS in the upper extremities due to pressure of a cervical rib are either neurologic or vascular in nature. Instances of serious vascular disturbance due to such an abnormality are relatively unusual.[1-3] The following case is of interest not only because of the marked vascular impairment, but also because of the complete anatomical and functional recovery which took place after operation was performed.

CASE REPORT

The patient, a married white woman, 38 years of age, was referred to me on Nov. 25, 1938. For one month previous to her admission to the hospital she had been complaining of pain in the left upper extremity. Whenever she raised her left arm to comb her hair or put on a dress, she precipitated an attack of pain. This was regarded as due to a neuralgia and was treated with codeine and aspirin. Two days before admission her pain suddenly became much more severe and she developed a sensation of numbness in the left hand. Her past history was entirely negative except for an appendectomy many years ago. She did not use tobacco.

The patient was a well-nourished, middle-aged woman whose general physical examination was essentially negative. In the left supraclavicular space a bony prominence could be felt which suggested a cervical rib. The pulsation of the subclavian artery was prominent over it. There was a good pulsation in the left axillary artery but no pulsation in the left brachial, radial, and ulnar arteries. The circulation in the right upper and both lower extremities was normal. The left forearm and hand were much colder than the right. The oscillometer readings in the upper extremities were as follows:

	LEFT	RIGHT
Upper arm	Faint	6
Forearm	0	5½

She was referred to the Mount Sinai Hospital and was admitted to the Surgical Service of Dr. John H. Garlock. There temperature studies revealed that the fingers of the left hand were about 7° C. lower than the right. The left axillary pulsation could no longer be felt. No motor or sensory disturbances were noted in the left upper extremity. The blood pressure in the right arm was 126/84. In the left arm the blood pressure could not be obtained. The Wassermann test was negative.

X-ray examination of the cervical spine showed a long transverse process of the seventh cervical vertebra on the right side. On the left side there was a cervical rib composed of at least three segments which articulated with each other.

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On Dec. 1, 1938, operation for removal of the left cervical rib was done by Dr. John H. Garlock. Avertin, ethylene, and ether anesthesia was used. The operative procedure is described by Dr. Garlock as follows:

"Transverse incision, 6 inches in length, 1 inch above clavicle. Platysma incised. Sternomastoid muscle retracted medially. Incision deepened exposing the anterior scalene muscle. The phrenic nerve was found running on its anterior surface above, extending downwards and going behind the scalene muscle and cervical rib. The muscle was attached to the cervical rib and by another prolongation to the first rib.

"The tendinous insertion in both ribs was divided, exposing the cervical rib. Considerable retraction was necessary in order to expose this structure adequately for removal. The lower cords of the brachial plexus were retracted medially and downwards. The transverse scapular artery was visible and found to be three to four times normal size, pointing toward an adequate collateral circulation. The subclavian artery was felt pulsating mesial to the position of the rib and apparently ran between the cervical rib and the first rib. The dissection was long and difficult. The rib was finally removed close to its attachment to the spine and traced downwards and outwards to a bulbous enlargement which marked the joint space visible in the x-ray. Beyond this space was another ¾ inch of rib which was united to the upper aspect of the first rib by bony union. The entire rib was removed. It was difficult to determine whether pulsation was present distal to the previous position of the cervical rib. Because of ooze from the side of the vertebral column, a piece of packing was inserted and the wound was closed in layers."

The wound healed by primary union. The patient was out of bed on the sixth postoperative day and was discharged from the hospital on the thirteenth postoperative day. On Dec. 6 oscillometer readings were repeated and showed the following:

	LEFT	RIGHT
Lower arm	0	2½
Upper forearm	0	4

On Dec. 7, one week after operation, Dr. Garlock noted that there was no evidence of pulsation at the left wrist. Skin temperature readings were repeated on Dec. 12 and showed considerable improvement in the temperature of the left hand. The comparative readings were as follows:

	11/28		12/12	
	LEFT	RIGHT	LEFT	RIGHT
Forearm	31.8° C.	34.0	31.0	32.6
Wrist	30.0	34.6	31.8	32.6
Back of hand	30.6	34.2	32.2	33.6
Tip of middle finger	27.6	34.6	31.0	32.6

On Jan. 19 the patient reported that she had had no pain since operation. No pulsation was felt in the left hand. The hand was warm, showed good color and prompt return of circulation after compression of the nail beds. On Feb. 16 the left radial pulse was felt for the first time and it was noted that the left hand was only slightly colder than the right. On April 20 patient was symptom free. The radial pulse could now be easily felt on the left. The two upper extremities were symmetrical in appearance and function was normal.

On May 12, 1939, examination showed the left brachial, radial, and ulnar pulses open. The pulses on the left side were slightly smaller than on the right. Both hands are equally warm. The oscillometer readings were:

	LEFT	RIGHT
Wrist	2½	3

The patient was symptom free. She had made a complete anatomical and functional recovery.

COMMENT

Opinion is divided as to the cause of the vascular disturbances produced in the upper extremities by cervical ribs. At first it was generally believed that direct pressure of the rib upon the subclavian artery caused obstruction to the vessel at that point. However, Telford and Stopford[4] reported three instances of cervical rib with vascular impairment in which the axillary artery could be felt pulsating, and the site of obstruction appeared to be the brachial artery. They pointed out that the vascular occlusion ended abruptly in the region of the lower border of the insertion of the pectoralis major muscle. At operation they could find no evidence in any of their three cases that the subclavian artery was being constricted by pressure from the cervical rib or adjacent structures.

If pressure of the cervical rib on the subclavian artery is responsible for the vascular impairment, how is one to explain the pulsation in the axillary artery? Telford and Stopford offered the following explanation: The sympathetic nerve fibers which innervate the brachial artery and its branches sometimes form a compact band lying on the inferior surface of the inner cord of the brachial plexus. They pass into the arm with the major nerves and are given off at succeeding levels to the large arterial trunks. Constant irritation of these fibers as they pass over a cervical or high first rib results in recurring spasms of the brachial artery which finally result in thrombosis of this vessel. The sympathetic innervation of the subclavian and axillary artery is derived directly from the sympathetic chain, the fibers extending out to the arm as a perivascular plexus. For this reason this portion of the artery is not affected.

Blair, Davies, and McKissock[5] describe a case of cervical rib in which pulsation in the axillary artery was normal and occlusion was present in the brachial. At operation the subclavian artery was found to be free of any constriction or pressure by the cervical rib. This patient died ten days after operation of a pulmonary condition and it was possible to examine the brachial plexus from end to end by serial sections. The lower trunk of the plexus and the first dorsal nerve showed histologic evidence of proliferation of endoneurium and endoneurial nuclei where these nerve structures came into relation with the cervical rib. The authors regarded this as evidence of irritation of these nerve structures by the rib. They agreed with Telford and Stopford that sympathetic irritation produced in this manner was responsible for the clinical picture.

In the present case pulsation in the left axillary artery was easily felt when the patient was first seen, but this disappeared shortly after admission to the hospital. Anatomical recovery was complete and occurred in a relatively short time. While recanalization of a com-

pletely thrombosed artery may have taken place, it is possible that release of spasm was the more important factor in the recovery. Prompt recognition of the cause of this patient's symptoms, and early surgical intervention before organized thrombotic occlusion had time to develop, may therefore be responsible for the excellent therapeutic result.

Naffziger[3] pointed out that patients may have all the symptoms of cervical rib even though no such abnormality is present. Since then considerable attention has been drawn to the so-called scalenus anticus syndrome. The subclavian artery and brachial plexus pass through the neck behind the scalenus anticus muscle. When this muscle is tense, symptoms develop which are similar to those produced by a cervical rib. These are completely relieved by section of the scalenus anticus muscle, which allows the artery and plexus to be displaced forward.

SUMMARY

A case of advanced vascular impairment in the upper extremity secondary to cervical rib is presented.

Complete anatomical and functional recovery followed prompt recognition of the cause of this patient's symptoms and early surgical intervention.

The mechanism which produces the vascular impairment associated with cervical rib is discussed.

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ACUTE FREE PERFORATION OF THE GALL BLADDER OCCURRING TWICE IN THE SAME PATIENT

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PERFORATION of the gall bladder is more common than is generally appreciated. Three types are recognized: chronic perforation with presence of a fistulous communication between the gall bladder and some other viscus; subacute perforation, in which the perforation is surrounded by an abscess walled off by adhesions from the general peritoneal cavity; and acute perforation into the free peritoneal cavity.

A review of the literature shows that this third type, designated as "acute free perforation," is uncommon, is rarely diagnosed preoperatively, and carries a high mortality. McWilliams[1] collected 108 cases from the literature and in his own series of 3,180 gall-bladder cases found 29 perforations, of which 6 were acute. Gosset[2] reported 111 cases with a mortality of 52 per cent. Georg[3] recorded 348 cases found in the literature prior to 1925 with a mortality of 42 per cent. Fifield[4] found 27 cases of perforation in a total series of 1,066 gall-bladder cases, with a mortality of 44 per cent, but, of these, only 17 were acute free perforations. Alexander[5] cited 1,000 cases of biliary disease with 20 perforations, of which only 8 were acute, with a mortality of 50 per cent. Mitchell[6] reported 16 perforations in 1,270 gall-bladder operations with a 50 per cent mortality, including 6 cases of acute free perforation. During a ten-year period at the Mayo Clinic, Judd and Phillips[7] recorded 61 cases of perforation, in only 2 of which were there extravasations of contents into the general peritoneal cavity. Of 349 operations reviewed by Niemeier,[8] 8 perforations were encountered, but only 2 were of the free acute type; and Larson[9] found 12 cases in 706 operations with a mortality of 50 per cent.

Such statistical considerations indicate that perforation of the gall bladder is not rare, occurring as it does in approximately 1 to 3 per cent of gall-bladder cases. If these statistics are further analyzed, it becomes apparent that acute free perforations into the general peritoneal cavity occur in less than 1 per cent of all gall-bladder cases. While the incidence of such occurrence is remarkably small, the important consideration is that it does occur and should consequently be considered when treating gall-bladder patients.

Perforation of the gall bladder twice in the same patient is an extremely rare occurrence. A careful review of the literature reveals only one such report, that of Fisher and Mensing in 1926.[10] It is because of its rarity that we wish to record the second case. With both perforations bile escaped into the free peritoneal cavity causing pro-

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found symptoms, and, after the second rupture, although the diagnosis was seriously suspected, no surgery could be instituted because of the patient's extremely poor condition.

CASE HISTORY

The patient, a male, aged 36 years, was first seen on April 7, 1938, complaining of sharp, knifelike pain in the upper right abdomen, radiating to the back and associated with some nausea but no vomiting. This was his first acute attack, although for several months previously he had experienced mild recurrent epigastric pains and a selective dyspepsia.

He was not seen again until Aug. 21, 1938, when he experienced another acute attack. In the intervening five months he had had no distress and had been under the observation of another physician who had carried out x-ray studies of the gall bladder which showed some filling defects suggestive of but not conclusive for cholelithiasis. While dressing on the morning of Aug. 22, he suddenly experienced a severe, persistent, knifelike pain in the upper abdomen associated with profuse perspiration and marked nausea. Examination shortly afterward revealed marked tenderness and rigidity over the entire right abdomen. Relief was obtained with morphine and atropine, but one hour later the severe pain recurred, this time mainly in the right shoulder and right lower abdomen. Examination at this time revealed marked tenderness and rigidity over McBurney's area.

Suspecting the possibility of simultaneous pathology in the gall bladder and appendix, the patient was hospitalized and surgical consultation obtained. On admission the temperature was 101° F. (rectally); pulse, 130; and blood pressure, 120/80. The next day the patient began to cough and examination revealed sibilant and sonorous râles throughout both lungs and dullness with distant voice and breath sounds at the right pulmonary base. A diagnosis of acute tracheobronchitis with right lower lung atelectasis was made and confirmed with portable roentgenograms. The abdomen was slightly distended, still markedly tender but less rigid. Temperature, pulse, respiration were 100°, 138, and 38, respectively; and the white count was 22,500 with 70 per cent polymorphonuclear leucocytes. In addition to the persistent shoulder pain, he complained of pain in the bladder region, particularly on voiding.

Because of the persistent, uncontrollable pain and increasing distention which failed to respond to Wangensteen suction, it was decided to operate. On opening the peritoneum, free bile escaped and about 500 c.c. were aspirated from the peritoneal cavity. The gall bladder was found ruptured at the fundus and 126 stones were scooped out from the gall bladder and the surrounding area. The entire bowel was markedly distended and injected. The gall bladder apparently had ruptured eighteen hours after the onset of the biliary colic, resulting in bile peritonitis and paralytic ileus. A tube was sewed into the gall bladder and the peritoneum was closed. The postoperative course was stormy. The ileus was controlled by constant suction, and a subsequent bilateral bronchopneumonia and severe phlebitis of the left leg were overcome.

The patient was discharged on Sept. 10, 1938, in fairly good physical condition except for a draining biliary fistula, through which he subsequently passed several small stones. Several weeks later he developed a large hernia at the operative site, but nevertheless, he was able to return to his work. On Nov. 29, 1938, lipiodol was injected into the fistulous tract and roentgenograms were taken with the patient in the prone position. These clearly outlined the sinus communicating with the gall bladder, the two main and several collateral divisions of the hepatic duct, the cystic duct and the common duct with its entrance into

the duodenum (Fig. 1). The fistula stopped draining and closed completely on Jan. 5, 1939. In the interim efforts to reduce the patient, who was obese, were made with advice to have the diseased gall bladder removed.

The patient was entirely symptom free until Jan. 24, at which time he experienced some mild pains in the right upper quadrant which spontaneously subsided within several hours. However, that night the abdominal pain recurred in a severe form with nausea and pain in the right shoulder. Between 9:00 and 11:00 P.M., 1¾ gr. of morphine in divided doses were administered with only slight relief and the patient was again hospitalized. Admission temperature was 101° F.; pulse, 95; respiration, 35; and white cell count, 22,800. The entire abdomen was tender, but rigidity was difficult to determine because of the large hernial

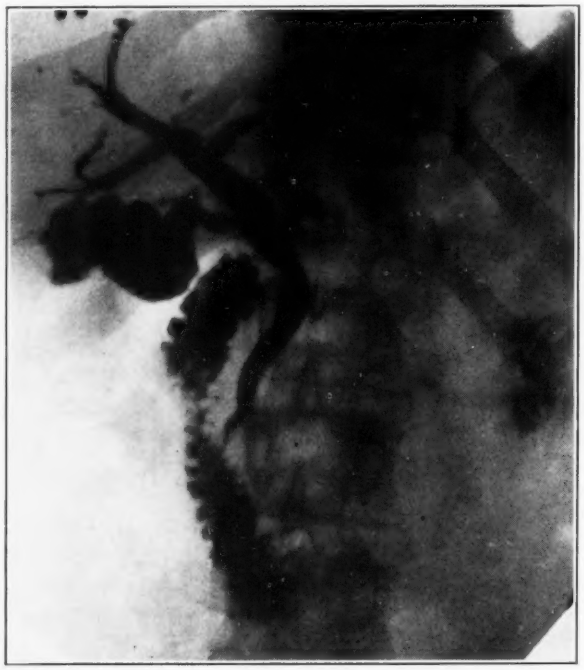

Fig. 1.—Lipiodol injected into the fistulous tract outlining the sinus communicating with the gall bladder, the two main and several collateral divisions of the hepatic duct, the cystic duct, and the common duct with its entrance into the duodenum.

mass occupying the upper right abdomen. The next morning he began to complain of pain in the lower abdomen and, while the possibility of a second gall-bladder perforation was entertained, surgery was deemed inadvisable because of the patient's poor condition. Shortly afterward he experienced a chill lasting twenty-five minutes; the temperature rose to 105° F. (rectally); pulse, to 140; and the blood pressure dropped from 130/80 to 110/70. Emergency treatment against peripheral vascular collapse was instituted, but within several hours the patient expired.

Autopsy was performed by Dr. I. Davidsohn, Mount Sinai Hospital, Chicago, Ill. The abdomen was distended and the upper right quadrant was occupied by a fluctuant bulging mass, 16 by 15 cm., the entire length of which was traversed by a surgical scar. Free bile, about 100 c.c., was present in the peritoneal cavity and the omentum and both peritoneal layers showed a yellowish green discoloration. The right subdiaphragmatic space also contained some free bile. The lower surface of the right diaphragm was also discolored and the upper surface was diffusely hemorrhagic.

The gall bladder was small with thickened walls and contained eight faceted stones. Through an opening in the fundus (8 mm.) at the lower margin of the liver, bile had apparently escaped (Fig. 2). The mucosa was atrophic throughout and adjacent to the perforation showed polygonal depressions forming a negative for two stones. The stones at the neck of the gall bladder protruded into the proximal portion of the cystic duct, which measured up to 10 mm. The common duct was patent. The adjacent liver surface showed hemorrhagic areas extending into the parenchyma. The fistula, beginning at the perforation in the fundus, was 3 cm. long, ending in a scar, beyond which it passed to the abdominal wall.

The heart showed evidence of eccentric hypertrophy and acute parenchymatous degeneration; the lungs showed acute passive congestion with hemorrhages; and the spleen, acute septic swelling. Bacteriologic examination of the peritoneal fluid demonstrated the presence of *B. coli* and *B. welchii*.

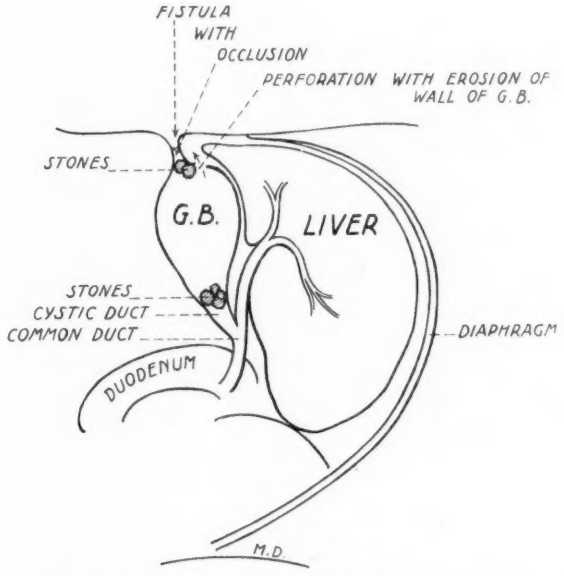

Fig. 2.—Semidiagrammatic sketch of the condition found at autopsy.

Histologic study of various tissues showed acute fibrinous diaphragmitis, chronic cholangitis, and acute fibrinous perihepatitis with multiple liver hemorrhages and nodular hyperplasia, chronic cholecystitis, acute nephrosis with acute passive congestion of the kidneys, hemorrhages in the gastric mucosa, multiple pulmonary hemorrhages, and acute fibrinous peritonitis.

The cause of death was an acute biliary peritonitis.

COMMENT

This unusual case demonstrates many points of interest. In both instances perforation apparently occurred within twenty hours of onset of the acute biliary colic. So short a time element is very unusual. In most instances fortunately perforations are not fulminating events. Theoretically at least, there is an excellent protection given the gall bladder by its surrounding anatomical structures; the parietal peritoneum, the undersurface of the liver, the transverse colon, and the omentum all tend to prevent infection from spreading, limiting the resulting peritonitis. In the series of cases reviewed by Judd and

Phillips,[7] the average duration of time from the onset of the attack to operation was twenty days. However, instances of sudden perforation with a formidable array of symptoms are to be found, but the diagnosis of this catastrophe is rarely considered, the most frequent diagnosis being perforated peptic ulcer, ruptured appendix, acute intestinal obstruction, and diffuse peritonitis of undetermined origin.

While most perforations are associated with the presence of stones in the gall bladder, instances of such rupture without presence of stones are recorded. Among the causes considered as leading to perforation are the following:

1. Overstretching, with or without stones.
2. Pressure of a stone upon the wall, causing ulceration.
3. Gangrene due to: (a) thrombosis of the vessels supplying the wall with or without stones; (b) circulatory obstruction due to pressure from stones; (c) diphtheritic, ulcerative infection of the wall, with or without stones; (d) carcinoma of the gall bladder; (e) infection passing through the wall, producing a localized pericholecystitis or pericholecystic abscess.

With both perforations the resulting symptomatology was practically the same; namely, pain in the shoulder due to diaphragmatic involvement, pain in the right lower abdomen simulating appendicitis due to seepage of the bile along the right trough into the pelvis with subsequent peritonitis and finally vesicle pain. The second perforation, while not entirely surprising, was unexpected because one month previously x-ray study had failed to reveal any stones present in the biliary system. Finally, the multiplicity of complications overcome by the patient is of medical interest, as is also the evidence establishing the fact that the peritonitis was not only in the nature of a response to chemical (bile) irritation but was rather of a true infectious type.

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POSTOPERATIVE SIMULTANEOUS, BILATERAL, SPONTANEOUS PNEUMOTHORAX

CASE REPORT

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SPONTANEOUS bilateral pneumothorax is a bizarre and infrequent condition. Only ninety-five cases have found their way into the literature, to date, but there are probably as many more unreported or unrecognized. Excellent reviews, periodically, by McMahon,[1] Glickman and Schlomovitz,[2] and Hasney and Baum[3] have summed up the general subject adequately, while several exceedingly interesting case reports are recorded each year under this title.

An arbitrary classification of bilateral spontaneous pneumothorax has been made and the terms simultaneous or successive bilateral spontaneous pneumothorax are used, the former indicating that condition where collapse is demonstrated on both sides at the same time or on the opposite side before all air on the original side has been absorbed, while the latter denotes alternating pathology.[2]

ETIOLOGY

Davies[4] very neatly sums up the causes as: (1) injury to chest wall, bronchus, or lung; (2) rupture of emphysematous blebs, congenital or otherwise; (3) perforation as result of disease, with tuberculosis as the most common, followed by gangrene, abscess, and including malignant metastases. All the known causative factors may be placed in one of these groups, but it appears that a fourth group should be added including the so-called idiopathic bilateral spontaneous pneumothoraces occurring in apparently healthy individuals.

Of the latter, many theories have been advanced in an attempt to explain them, but Schmincke,[5] in 1925, suggested possibly the most logical theory and presented microscopic corroboration. He declared that cystic dilatations made up of vacuolated subpleural spaces due to faulty formation of lung tissue could be demonstrated. These spaces communicated with alveoli, and with rupture of the dilatations spontaneous pneumothorax occurred. Since these dilatations were bilateral, a bilateral pneumothorax was easily explained.

SYMPTOMATOLOGY AND DIAGNOSIS

Rarely the symptomatology is so mild that the condition goes unrecognized and untreated, being found accidentally during examination for another condition, but usually a sudden onset of dyspnea with

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chest pain, cyanosis, and occasionally a slight rise in temperature indicates, of course, careful examination and roentgenologic study. Often there is marked collapse and occasionally subcutaneous emphysema. The diagnosis is based on findings of diffuse or local hyperresonance, tympany, and diminished breath sounds, with roentgenologic corroboration.

TREATMENT

Most cases require no treatment, the increased pressure usually being sufficient to close the opening and the air or fluid becoming absorbed. If there is tension pneumothorax, prompt aspiration or closed drainage is indicated, while oleothorax is recommended in recurring cases for the formation of adhesions (Graham, Singer, and Ballon[6]).

Davies[4] suggests further that, in those cases where the rupture is held open by bandlike adhesions, there must be resort to thermocautery or pneumolysis and some cases will even require thoracoplasty.

It should seem that in the broad realm of surgery, with its rather common pulmonary complications, there would be frequent thoracic catastrophes falling into this classification, but it is surprising to find that only two such cases have been previously reported and both of these within the last year.

In the case of Phillips and co-workers[7] the patient was a 29-year-old male on whom a gastric resection for duodenal ulcer was performed. He was given gas, oxygen, ether anesthesia, and near the end of the operation developed a cervical subcutaneous emphysema. The diagnosis was made by roentgenogram and the treatment was expectant in nature. The condition proved to be self-limiting, being due probably to ruptured emphysematous blebs, and the patient made an uneventful recovery.

In the case of Gjanković[8] the patient was a young male also undergoing resection for duodenal ulcer. Splanchnic block was used, but a general anesthesia was finally required in the face of the patient's extreme restlessness. A midline incision extending to the xiphoid process was used and early in the course of the operation the patient became deeply cyanotic. It was decided to continue and at the close there was marked thoracic subcutaneous emphysema. Pneumothorax readings revealed bilateral positive pressures and repeated aspirations of air were instituted. The patient was discharged in good condition and the author, in recapitulation, felt that he had entered both pleural cavities inadvertently through anomalous pleural reflections at the xiphoid.

In each of the above cases the patient was otherwise an apparently healthy individual. In the case herein presented, the bilateral pneumothorax did not occur until a few days postoperatively, the patient was a known asthmatic, and the course was benign as presented.

CASE REPORT

J. R. (Hospital No. 111704), colored male, aged 17 years, was admitted to the Harlem Hospital, Dec. 8, 1938, with a history of having been taken suddenly ill the previous day with cramplike intermittent abdominal pain which started at the umbilicus and radiated to the right lower quadrant of the abdomen. There was no vomiting or untoward symptoms relevant to the other systems. The patient had had intermittent asthmatic attacks since the age of 2 years.

Physical Examination.—This was essentially negative, other than that relative to the abdomen and chest. The patient was apparently acutely ill. Abdominal tenderness was present below McBurney's point, with muscular spasm and rebound tenderness evidenced. There were many wheezy, harsh, sibilant râles heard throughout the chest. Clinical diagnosis: acute appendicitis and bronchial asthma.

Operation and Subsequent Course.—On Dec. 8, 1938, an appendicectomy was performed under spinal anesthesia. The appendix was found to be acutely inflamed. The patient's condition was quite normal until the fourth postoperative day, when an attack of asthma occurred. On the sixth day, Dec. 14, the temperature rose to 101.8° F. and moderate dyspnea developed, accompanied by intermittent substernal pain and attacks of coughing. The appendicectomy wound drained some serosanguineous material. Examination of the chest revealed scattered musical râles throughout with somewhat diminished breath sounds on the right.

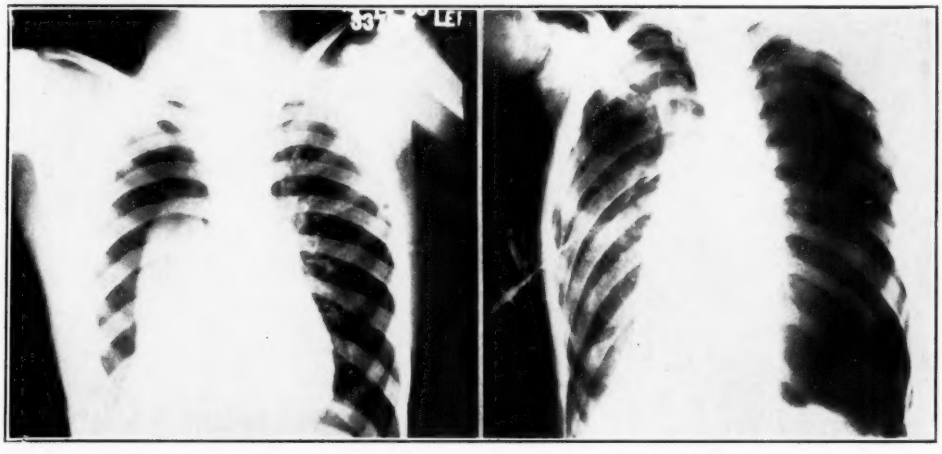

Fig. 1. Fig. 2.

Fig. 1.—Marked spontaneous pneumothorax on right side. Broad adhesion at apex. Slight mediastinal shift to left.

Fig. 2.—Decompression needle in situ on right side with mild improvement in the pneumothorax. A moderate pneumothorax is seen on the left. This was not noted on immediate examination of the wet plate, but was recognized two days later when the roentgenograms were reviewed.

A roentgenogram of the chest at this time (Fig. 1) revealed a spontaneous pneumothorax on the right side with a broad adhesion at the apex and a slight mediastinal shift to the left. The intrapleural pressures were right side, minus 2, plus 3; left side, minus 10, minus 3; no decompression was attempted. On the following morning, the patient became markedly dyspneic and cyanotic. Three hundred cubic centimeters of air were aspirated from the right pleural cavity which resulted in some relief of the dyspnea.

By noon, the intrapleural pressure, right side, was minus 8, plus 3; 800 c.c. of air were withdrawn; pressure was minus 10, minus 3. Underwater drainage was established. Four hours later, the pressure was minus 12, plus 2, and 150 c.c. more of

air were withdrawn; pressure, minus 10, minus 2. Twelve hours later the pressure was minus 8, plus 2, and 400 c.c. more of air were withdrawn; pressure, minus 10, minus 2.

On Dec. 16, 1938, pressure was minus 8, plus 8, and 1,200 c.c. of air were withdrawn; pressure, minus 10, minus 0. Intercostal drainage was established and 10 c.c. of lipiodol was injected into the pleural space; pressure, minus 8, minus 2. Roentgenologic examination (Fig. 2) just prior to the insertion of the intercostal tube revealed slight improvement, but a moderate pneumothorax on the left side was overlooked at this time.

Two days later, Dec. 18, pressure was minus 1, plus 3; drainage tube was removed, cleaned, and replaced. The pressure oscillations were very small. At this time, the patient was somewhat dyspneic and distressed by an irritating cough. Percussion demonstrated hyperresonance over the left chest, with diminished breath sounds and scattered, distant, musical râles. Roentgenogram (Fig. 3) revealed full expansion of the right lung with lipiodol scattered over the lower lobe and a marked pneumothorax on the left. The intrapleural pressures were right side, minus 2, minus 0; left side, minus 10, minus 3. In spite of the negative pressure and because of the marked dyspnea, 400 c.c. of air were withdrawn with beneficial results.

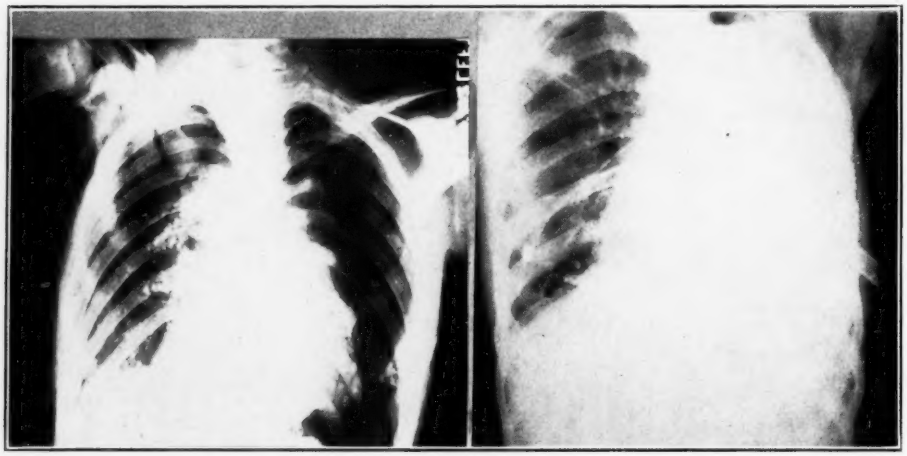

Fig. 3. Fig. 4.

Fig. 3.—Right lung expanded. Thoracotomy tube in seventh intercostal space and lipiodol scattered over lower lobes. Left lung is now seen to be almost completely collapsed.

Fig. 4.—Pleural effusion almost completely fills the left chest. Thoracotomy tube in situ on the left. Mediastinum moderately displaced to the right.

During the next two days the pressure readings fluctuated on the negative side, but the dyspnea was unimproved, necessitating repeated withdrawals of air on the left side. Dec. 21, 1938, it was decided to discontinue intercostal drainage on the right side and establish it on the left. This was done and 10 c.c. of lipiodol was instilled into the left pleural sac. This resulted in a marked pleuritic reaction with massive effusion (Fig. 4), which became apparent on the following day. The dyspnea increased and the intercostal tube was repeatedly plugged with fibrin, necessitating its removal. Dec. 22, 1938, the patient was improved, less dyspneic, and it was decided to refrain from a chest tap in order to avoid contamination of the fluid.

There was gradual improvement in the patient's local as well as general condition, and except for occasional pain in the left chest recovery was uneventful. Repeated roentgenograms revealed gradual absorption of the pleural fluid (Figs. 5, 6, and 7) and the patient was discharged Jan. 7, 1939, in good condition. Discharge diagnosis:

Acute appendicitis; bronchial asthma; pulmonary emphysema; bilateral spontaneous pneumothorax; pleurisy with effusion, left chest.

Follow-Up.—Patient returned to clinic for dressings of left thoracotomy wound. He resumed normal activity and had no complaints other than occasional left chest pain and asthmatic attacks. Feb. 1, 1939, roentgenologic examination of the chest revealed almost complete absorption of the fluid in the left thorax with lipiodol markings over both lungs. Feb. 6, 1939, he was readmitted to Harlem Hospital during a rather severe asthmatic attack and at this time a small abscess was noted in the region of the left thoracotomy wound. The asthma was effectively treated

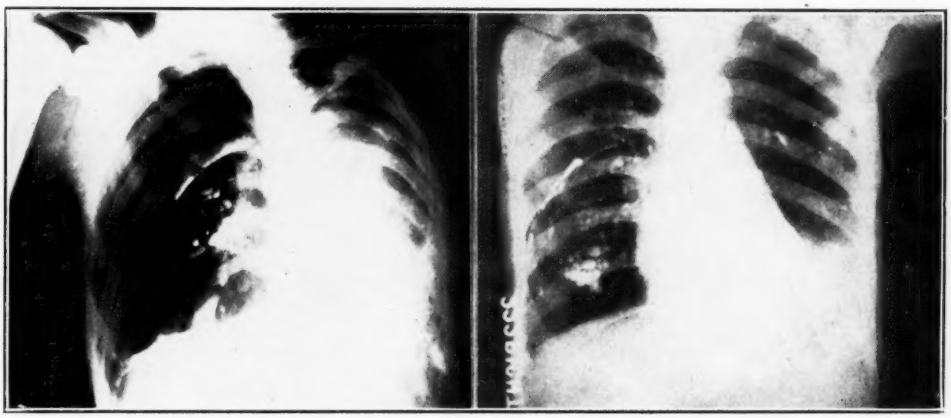

Fig. 5. Fig. 6.

Fig. 5.—Pleural effusion on the left is beginning to be absorbed. Lipiodol seen on both sides.

Fig. 6.—Pleural effusion continues to be absorbed and above it the left lung is fully expanded.

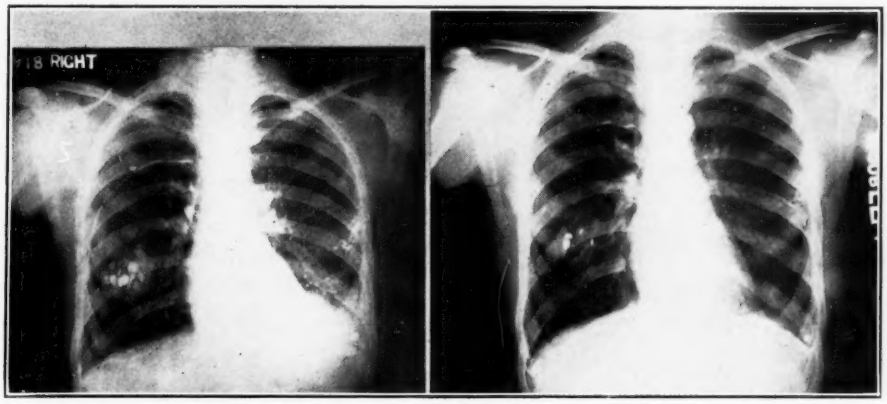

Fig. 7. Fig. 8.

Fig. 7.—There is small amount of residual fluid in the left chest on discharge of the patient. Lipiodol markings seen on both sides. On the right side the interlobar fissure is outlined by lipiodol.

Fig. 8.—Both lung fields clear, except for persistent lipiodol markings.

with doses of adrenalin alternated with ephedrine. The abscess evacuated itself spontaneously and the patient was again discharged in good condition Feb. 16, 1939. On June 26, 1939, he returned to Follow-up Clinic and reported that he had had no complaints during the ensuing time. A roentgenogram at this time revealed only persistent lipiodol markings (Fig. 8).

SUMMARY

An interesting and very uncommon postoperative pulmonary complication, together with a short review of the literature, is presented.

The two similar previously reported cases are reported in abstract.

In this case the bilateral spontaneous collapse was due undoubtedly to ruptured emphysematous blebs.

The treatment as outlined here is suggested for that case where expectant therapy or simple decompression is ineffective. The lipiodol is used as an irritant, causing a sterile pleuritis with resultant closure of the rupture.

In all recorded cases the prognosis has been good, except where the etiologic factor has been tuberculosis or similar chronic pulmonary pathology.

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RECURRENT ECHINOCOCCUS CYST OF THE THIGH*

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ECHINOCOCCUS disease is an uncommon entity, save in portions of the world where sheep raising is a major industry; yet failure to consider the possibility of this diagnosis may prove embarrassing to the surgeon and a source of real danger to the patient. In the case to be cited, the diagnosis of echinococcus cyst of the thigh was not considered. At operation by the surgical resident the cyst was incised and the wound was contaminated with daughter cysts and, despite prophylactic precautions, the cyst recurred.

Prior to discussion of the case, we wish to quote freely from a recent detailed article by Dew:[1] "The *Echinococcus granulosis*, which inhabits the small intestines of the dog, measures 6 mm. in length and consists of a head and three or four segments carrying about 800 eggs in the terminal segment that are discharged into the bowel lumen. The dog became infested by eating the contaminated viscera of the sheep, ox, or pig. While man is also an intermediate host, since his infected flesh and viscera is not available to the dog, mans" is a dead end infestation. The manner in which man becomes infested was discussed in detail; such means as contaminated water and foodstuffs were thought to play minor roles. Dew feels that the most important source of infestation is the hands soiled in petting an infested dog. The chitinous covered eggs, 35 mm. in length, are swallowed. The gastric and intestinal juices free the active portion, which bores through the gut wall, enters the portal system, and, dependent upon passage of the liver, reaches the pulmonary circulation which, if successfully passed, allows any portion of the body to become the site of a mother cyst. In Dew's series the following sites are reported:

Liver	76.6%
(The right lobe of the liver was involved in 80% of above group and in 70% of instances there was an abdominal projection)	
Pulmonary	9.4%
Muscular and subcutaneous	5.2%
Kidney	2.3%
Spleen	2.1%
Bones	0.9%
Orbit	0.7%
Brain	0.6%
Other sites	2.2%

In man the active head develops a cyst wall surrounded by a cellular reaction area laid down by the host. Eventually within the cyst perpetuation of the cestode is attempted by appearance of daughter cysts.

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The aforementioned cyst wall is selectively permeable, preventing the entrance of noxious materials which might kill the cysts. The daughter cysts vary from undifferentiated cellular masses to those which contain well-differentiated scolices. Dew believes that infestation occurs in childhood in a majority of instances and thus the cyst is nearly as old as the patient. This extremely slow rate of growth is a feature not appreciated by most.

The diagnosis is not difficult where the condition is epidemic. In other localities, keeping the possibility of the infestation in mind is perhaps the most important point, since the features which differentiate it from other masses cystic in type may then be considered. Laboratory aids are the x-ray and the complement fixation test of Fairley, in which fresh hydatid fluid from sterile sheep cysts is used as antigen. Formerly the intradermal test of Casoni and the precipitin test of Flieg and Lisbonne were used, but with variable results.

The treatment is en bloc excision when the site of the disease permits, exercising the greatest of care to prevent spillage into fresh wounds. When this procedure cannot be done, marsupialization and treatment of the cyst wall with formalin must be done. This method is to be avoided wherever possible since there may be a draining sinus for months or years.

CASE REPORT

The patient was an Italian male, 48 years of age, who, because of dislike of dogs dating from childhood, had always avoided them. Three years before the initial admission, he had noticed a slowly growing fluctuant mass 10 by 12 by 6 cm., nontender, on the lower outer aspect of the right thigh. When the skin over it became reddened, he sought medical advice and was admitted to the surgical service of the late Dr. John Speese in the Presbyterian Hospital. History and examination plus normal laboratory findings pointed to a diagnosis of lipoma. The x-ray report was positive for a soft tissue tumor. In attempting to enucleate the tumor, the surgical resident broke through a cyst wall, at which time the true diagnosis was made. There was spillage. The wall of the mother cyst was completely excised and the wound carefully washed out with formalin solution. The wound healed without incident and the patient was discharged on May 29, 1932.

The pathologist reported echinococcus cyst with multiple daughter cysts. X-ray studies were made of lung and bone without finding lesions. He was given periodic physical and laboratory examinations, including x-ray, for a period of eighteen months. Attempts at culture, as suggested by Dew,[2] were made in three rabbits, but we were unable to transmit the disease in any instance. At the conclusion of this follow-up period, Dr. John Speese and I[3] reported the findings as an apparent cure.

The patient reappeared in May, 1935, with a recurrence at the site of the original lesion. As on previous admission, physical findings, save a cystic lesion 8 by 8 cm., and laboratory studies were not helpful or significant. He was submitted to surgical exploration on May 22, 1935 (by J. B. M.) and a careful en bloc excision of the recurrent echinococcus cyst was carried out. The lesion in this instance extended from just above the level of the joint line on the outer aspect of the right thigh upward and inward spreading muscle bundles until it almost reached the femoral shaft at its midportion. The proportion of the cyst which

pierced the muscles and extended towards the femur was a tongue some 4 inches by 1 inch by 1 inch. Spillage did not complicate this procedure. The pathologist reported a mother cyst with multiple daughter cysts within the excised tissue. The patient was again carefully followed for a period of five years. At his last visit the chest was again negative for disease, a complement fixation test was negative, and the site of operation was negative save for muscle hernia due to loss of fascia. Wassermann and Kline tests were negative also. The complement fixation test for echinococcus disease is negative if there is retention of hydatid fluid within the cyst walls since there will then be no circulating complement. This feature makes this test of less significance. Because of the reappearance within eighteen months and the fact that now after five years there is no reappearance of the lesion, it seems reasonably sure that the patient is disease free from *Echinococcus granulosis*.

COMMENT

This case has been reported because the experiences which we had point out the pitfalls in dealing with an entity uncommon in this country. The diagnosis was not considered and, after too short a follow-up period, cure was reported, failures we believe to be of value and worth reporting. This case calls attention to the fact, then, that any cystic mass may be echinococcic in origin. One does not expect the disease to ever attain even endemic proportions in this country due to the rigid care in the abattoirs in both the acceptance of animals for food purposes and the disposal of the entrails and viscera during the processing of the meat. An interesting feature of both the initial lesion and the recurrent one is that each was a mother cyst with multiple daughter cysts, which is a contradiction to the reports by Dew. He has stated that, when the rupture[2] of a cyst occurs, secondary cysts are simple cysts and rarely larger than hen's eggs. The initial cyst was clearly not of secondary origin but must have been caused by a single infective scolex passing all barriers to reach the subcutaneous tissues of the thigh. The operative rupture caused spillage and secondary cysts, which, in this instance, does not conform to Dew's dictum, since it was again a mother with multiple daughter cysts and it recurred within a period of eighteen months and had attained nearly the size of the initial cyst. If the original invader had been present since infancy, certainly the operative interference caused the recurrent cyst to grow at an inordinate rate. This makes one wonder if the first lesion was not implanted some few years before it was first noticed. It is not the desire to dispute so distinguished an authority as Dew, but where contrary findings are to be found they should be so reported.

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A TIDAL IRRIGATOR*

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WHILE using Monro's[2] tidal irrigator on paralytic bladders in the Department of Urology, we were impressed with the amount of nursing and intern care required to keep the apparatus functioning properly. There appeared to be several undesirable features involved in the mechanics of it which we felt might be corrected. It also seemed practical to modify its construction sufficiently to allow more forms of irrigation and to make provision for cystometric studies without necessitating transportation to the clinic or the use of a second apparatus. Certain modifications of the Monro tidal irrigator were made which seemed to eliminate these difficulties.

The rubber tubing and glass connections of Monro's tidal irrigator were unstable. They easily became air-bound or kinked, resulting in disturbance or failure of siphonage. Adjustments of siphon and siphon-reservoir bottle height were difficult in adaptation to the changing needs of the patient from day to day. Consequently our irrigator was constructed on an adjustable and protective mounting as shown in Figs. 1 and 2. Rubber tubing was replaced with glass tubing so that stoppage by kinks and by becoming air-bound was eliminated. The resulting transparency made it easy to check the patency and efficiency of the system at a glance. The siphon height could be changed by loosening the thumbscrew (*13*). Not only did this allow fine adjustment, but it facilitated changing of the siphon height by any attendant when the patient was able to sit up in a chair. The protective mounting, as shown, has made breakage rare. In practice, the apparatus has been found to be quite foolproof and requires a minimum of care and comprehension.

Other disadvantages of the original irrigator which we sought to eliminate were the prolonged latent period and reflux. Between the time the siphon had broken, after emptying the bladder, and the time the level of fluid in the siphon and reservoir reached bladder level, drainage from the bladder was by gravity into the reservoir bottle (*4*). This created a latent period during which no bladder irrigation took place. Consequently, no dilutent or bacteriostatic fluid entered the bladder to match the ureteral output during that time. When irrigation did take place, the residual contaminated drainage in the tube leading from the catheter, was first refluxed back into the bladder ahead of the irrigating fluid. To reduce the latent period and prevent reflux, we

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took advantage of the Foley-Alcock catheter (*21*) and its counterpart, the two-way four-winged self-retaining female catheter (*22*). This allowed a separate direct intake (*2*) for constant irrigation. The intake, adjusted at three times the reservoir filling drip (*3*), assured a faster rate of bladder than reservoir filling. Many other types of siphon-breaking devices, such as flutter valves, rubber and glass air traps, and various combinations of siphon and reservoir were tried. These attempts further to imitate the normal filling mechanism of the normal bladder by entirely eliminating the latent period were unsuccessful.

The use of the self-retaining catheter not only made constant irrigation possible, but by internal fixation assured uninterrupted and dependent bladder drainage at all times. Such internal fixation reduced urethral friction since the catheter was thus independent of body motion. The coincident elimination of adhesive strapping facilitated drainage of any urethritis which might be present. By using a small catheter (No. 18 F.), urethritis and prostatitis were further reduced to a minimum.

Our apparatus, modified from Monro's as above described, operates as follows: From the two-liter flask (*1*), the irrigating fluid goes through the intravenous dropper (*2*) directly to the bladder as a constant intake. At the same time, fluid is dropping through the Murphy dropper (*3*) into the larger tube (*11*) to the reservoir bottle (*4*) at one-third the rate. This glass tube lead is loosely sleeved inside the larger tube to allow changing of the siphon height. In Fig. 1 the reservoir intake is shaded out to show that the apparatus may be further simplified by its omission. If omitted, the reservoir intake tube becomes strictly an air vent and manometer, and its caliber 4 to 5 mm. instead of 10 mm. This manometer tube ends directly through the rubber cork in the reservoir bottle (*4*). The outlet of the bottle is a glass tube (*5*), extending nearly to the bottom and having a partially fused end (*6*) between ¾ and ½ mm. This connects with the T-tube (*7*) through *8*. The upper limb of the T-tube is the siphon (*9*) and the lateral limb is the bladder outlet from the main tube (*10*) of the catheter. Fluid rises in the reservoir or siphon-breaking system (*6*, *5*, *7*, *8*, *12*) until it reaches bladder level, usually at *13*, after which the intravesicular pressure builds up gradually to the height of the siphon (*9*). When fluid goes over the siphon bend, tripping the emptying mechanism, it begins drawing fluid both from the reservoir system (*6*, *5*, *7*, *8*, *12*) and from the bladder simultaneously. The pull on this system goes through the partially-fused end (*6*) whose diameter is approximately one-third that of the smallest constriction in the catheter and bladder outlet tubes. The speed of withdrawal of fluid from the bladder is greater than that from the reservoir system by several times.*

*Poisuille's Law: "The speed of currents in capillary tubes is proportional to the square of their diameters."

In addition, the center of level of the reservoir system is about one-third as high as that of the bladder and therefore subjected to less than one-third the siphonage exerted on the bladder.* It follows that

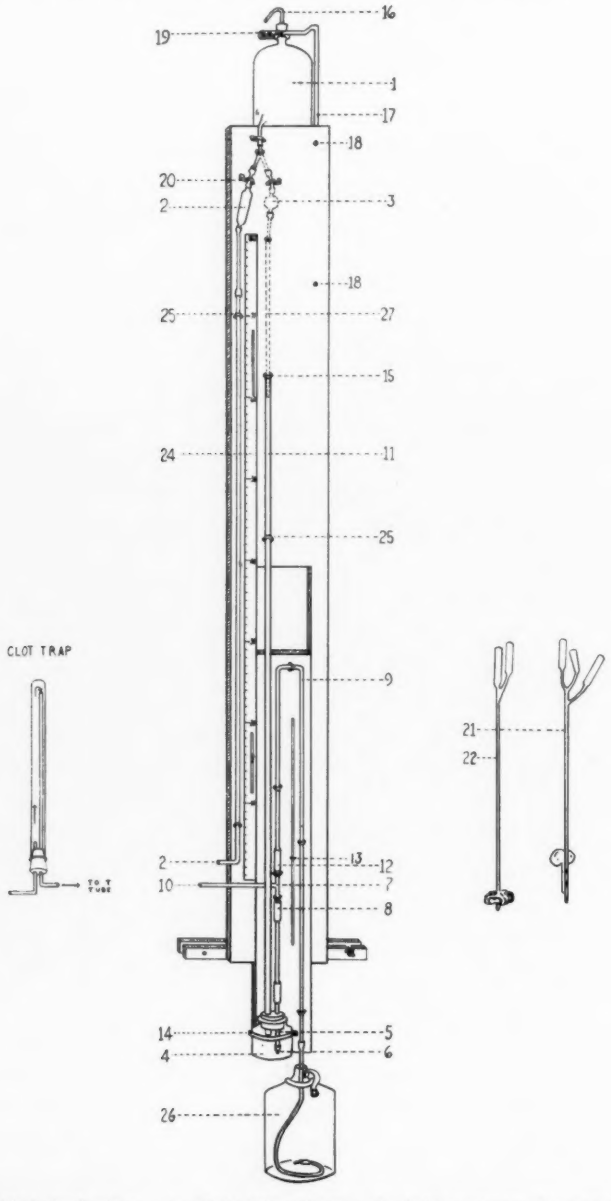

Fig. 1.—Tidal irrigator. *1*, Two-liter flask; *2*, intravenous dropper; *3*, Murphy dropper; *4*, reservoir bottle; *5*, glass tube; *6*, partially-fused end of glass tube; *7*, T-tube; *8*, rubber joint; *9*, siphon; *10*, main tube from catheter; *11*, manometer; *12*, rubber joint; *13*, thumbscrew; *14*, thumbscrew clamp; *15*, rubber washer; *16*, cork and U-tube; *17*, bottle rack; *18*, thumbscrew; *19*, rubber band; *20*, Hoffman clamp; *21*, Foley-Alcock catheter; *22*, Two-way, four-winged, self-retaining female catheter; *24*, 80 cm. metric ruler; *25*, glass-holding bracket; *26*, 1-gallon jug; *27*, glass tube.

*A corollary to Pascal's Law concerning the dependency of depth of fluid in the transmission of pressure equally in all directions. The corollary from this law is the law of siphonage which states that the pressure is a function of the difference between the levels of the liquids involved and is proportional to the square of the diameter of the siphon used.

the capacity of the reservoir system may be several times less than that of the bladder and still empty after the bladder has emptied. As soon as the reservoir system is empty, air rushes into the siphon through *6*, having a free communication with the outside through the reservoir intake tube or manometer (*11*), and siphonage is interrupted. Residual urine may be found by measuring the fluid deposited in *4* by agitation of the catheter while suprapubic pressure is exerted immediately after the siphon has broken. If the amount is significant, it means that the reservoir system is too small for the bladder capacity, and the easiest remedy is to make the fused end at *6* smaller. The height of the siphon, and therefore the capacity (and intravesicular pressure) in centimeters of water, may be varied to suit the particular stage or type of bladder as determined by cystometry.

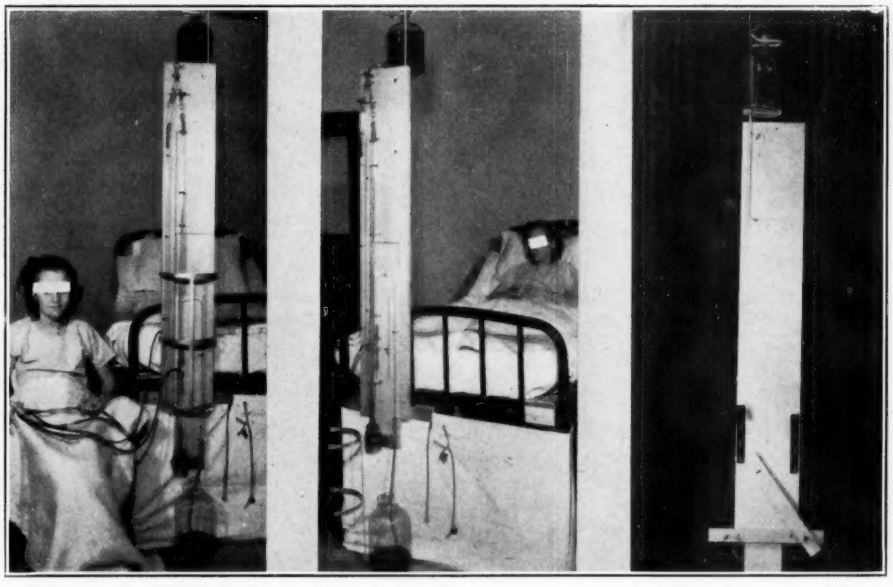

Fig. 2.—Irrigator in use with patient in bed, and in chair, showing advantage of adjustable siphon level (case of cauda equina bladder with infection).

All other forms of irrigation, except quick intermittent flushing, may be attained in the following manner: If constant siphonage is desired, with or without continuous irrigation, a clamp is placed on the rubber joint at *12*, cutting out the siphon-breaking reservoir system. The height of the siphon is immaterial.* If gravity drainage is wanted, the reservoir bottle (*4*) is removed and the lower end of the T-tube at *5* is connected to the waste bottle with a rubber tube. At present a clot trap is being constructed to be inserted at the lateral limb of the T-tube as it connects with the main tube to the catheter outlet so that it may be used routinely on postoperative patients. Emptying at low intravesicular pressure would be desirable so the siphon should be barely above bladder level.

The bottle (*4*) may be removed for cleaning by loosening the thumb-screw clamp (*14*). The rubber washer (*15*) is for dust-proofing the reservoir intake. The cork and U-tube (*16*) dust-proofs the two-liter bottle. The bottle rack (*17*) may be removed by loosening the thumb-screws (*18*) for transporting the patient through low doors. The bottle is held to the rack (*17*) by a strong rubber band (*19*). The Hoffman clamps (*20*) adjust the rate and ratio of fluid intake into the two systems. The tube clamps are made of welding wire and the bottle rack of rod iron. The rest of the materials and dimensions and costs appear at the end of this paper.

The apparatus is easily sterilized by running a 1:1,000 solution of mercury oxycyanide through the system with the catheter attached and placed in a convenient-sized basin for simultaneous sterilization. Distilled water or boric is used for thorough rinsing.

It is especially valuable to recheck by cystometry the progress or regression of paralysis so that the height of the siphon may be varied accordingly. If the capacity is lessened, the height is increased; if increased, it is lowered. Should paralysis regress to the desired normal reflex type of cord bladder with a low residual, and, if infection has been minimized, irrigation should be discontinued. Cystometry is accomplished by placing a hemostat at the rubber joint (*12*) cutting out the siphon. The partially fused end (*6*) is removed from the reservoir bottle to allow full oscillations in the manometer. The direct intake (*2*) is turned off and the centimeter ruler adjusted with its zero point at the level of the symphysis pubis. The T-tube is raised to the same zero point and the reservoir system filled until spill into the bladder is ready to occur. Since no graduated two-liter bottles are available at present, the bottle (*1*) must be replaced with an ordinary 1,000 c.c. graduated Kelley flask to measure the fluid used. By letting in fluid at (*2*) at a constant, moderately fast drip, direct manometric readings may be taken in centimeters of water in tube (*11*), usually after every additional 50 c.c. has run in. If a small manometric tube is used by eliminating the Murphy dropper intake, greater manometric excursions result and the readings become more accurate. To empty the bladder and measure accurately the amount withdrawn, a hemostat is placed at *8* and then the one removed from *12*. The siphonage is measured in the waste bottle.

Paralytic bladders have recently been reclassified in detail by McLellan.* It is not within the scope of this paper to enter into the controversy of irrigation vs. nonirrigation of cord bladders in the management of the various forms or stages of this distressing condition. At present even the atonic bladder is being irrigated with success.

Since its inception in June, 1937, the apparatus has been used off and on in University Hospital in the treatment of paralytic bladders

*For a full discussion, see McLellan.[1]

where irrigation seemed desirable, until at present it is replacing all other forms of irrigation of cord bladders. In using tidal irrigation, it is difficult for us to agree that this form of irrigation, simulating the emptying mechanism of a normal bladder as it does, has any effect of "education" toward the desired, so-called normal reflex type of cord bladder with a small residual urine. We prefer to believe that it helps (a) to retard the retrograde progress of infection from the bladder through the pelvic to the ureteral and renal lymphatics to its usual conclusion, by reducing vesicular infection when present; (b) to ablate residual urine where high and thus tend to prevent infection

List of Materials for One Irrigator

MATERIALS

1 piece of white pine, 52 inches by 8 inches by 1⅛ inches
1 piece of white pine, 26 inches by 4 inches by 11/16 inch by ½ inch
2 pieces of birch, 12½ inches by 1 inch by ¾ inch
1 piece of bar scrap iron for guard (*see* Fig. 1) 65 inches by ⅝ inch by ⅛ inch
1 piece of bar scrap iron for bed hooks (*23*) 24 inches by 1 inch by ⅛ inch
1 piece iron rod for 2-liter flask holder (*17*) 36 inches by ⅜ inch
2 2½ inch by 2 inch flat-head stove bolts
2 ½ inch by 4 inch round-head stove bolts
5 ¼ inch wing nuts (*18, 13*)
5 ¼ inch square nuts
5 ¼ inch iron washers
1 flat-head stove bolt with sing nut and washer 7/16 inch by 2½ inches
3 No. 8 1 inch flat-head iron screws, 11c gr.
6 No. 10 1 inch round head iron screws, 12c gr.
30 No. 3 ⅜ inch round head iron screws 09c gr.
4 ft. electrician wire solder for glass-holding brackets (*25*)
1 piece 7 inches by ⅝ inch by ⅛ inch brass or iron for bottle clamp (*14*)
1 wooden metric ruler 80 cm. long split (*24*)
⅛ pint varnish

GLASSWARE

1 2-liter male aspirating bottle (*1*)	$0.80
1 T-tube 4 mm. (*7*)	0.15
1 one-hole rubber stopper No. 3	0.02
2 Hoffman clamps (*20*)	0.20
1 IV drip bulb (*2*)	0.25
1 Murphy drip (*3*)	0.09
1 Y-connecting tube	0.08
3 ft. 0.8 cm. glass tubing (*11*) or 1 cm. if reservoir intake is to be used	0.03
2 70 cm. 4 mm. glass tubing (*25* and *27*)	0.06
4 15 cm. glass tubing	0.03
2½ ft. 4 mm. glass tubing	0.03
1 solid rubber stopper, No. 9	0.10
1 100 c.c. specimen bottle (*4*)	0.15
1 1-gallon jug (*26*)	0.15
25 cm. rubber tubing—IV 6 mm.	0.08
6 8 ft. rubber tubing, red, ¼ inch by 3/32 inch	1.44
2 glass connectors 3 inches by 5/16 inch	0.08
	$3.72

Carpenter labor	9 hr.		
Metal worker	1 hr.		
Painter	½ hr.		
Approximate labor cost		$8.86	
Material cost		3.48	
Glassware costs		3.72	
Complete total cost			$16.06

in certain types of bladders; (c) to keep the bladder musculature from distortion, contracture, or hypertrophy; (d) to add to the comfort of the patient; and (e) to facilitate nursing care. In other words, we prefer to look upon its function as that of any other form of physical therapy to a paralyzed muscle in helping to prevent deformity and preserve its relationship to as close to normal or physiologic as possible. The frequency of emptying, the intravesicular pressure (controlled by height of siphon), and the solution used in irrigation then must be varied to suit the individual type of paralytic bladder and the type and degree of infection present. If the paralysis is temporary and the "infantile" (uninhibited[1]) type of cord bladder, or normal reflex with low residual urine is attained, the physical therapy of the irrigator in the interim theoretically reduces the amount of irreparable damage to a minimum.

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LOCALIZATION OF OCCULT LIVER ABSCESS DURING LAPAROTOMY UNDER PROCAINE INFILTRATION ANESTHESIA

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THE classical symptoms and signs of liver abscess are sufficiently well known. Equally appreciated is the difficulty in locating an abscess in the liver. A small abscess may not be visible on the surface of the liver, nor can it be palpated with the exploring finger. Our experience with a recent case treated in the Johns Hopkins Hospital may afford a means of localizing such small abscesses.

CASE HISTORY

S. W. (Unit 156859), negro, male, 42 years of age, came to the hospital on Nov. 1, 1938, complaining of weakness and pain in the lower right chest and upper right abdomen. He stated that his mother and one brother were known to have diabetes mellitus. Seven years previously an appendical abscess had been successfully treated. He also stated that during his naval service in the past war he was ashore in both South America and the West Indies. He dated the onset of his present illness to September, about eight weeks before admission, when he first noticed weakness, thirst, and frequency of urination. Three weeks before admission he began to have pain in the lower right chest. During the past month he also noticed loss of appetite, fatigability, and loss of twenty pounds in weight.

Physical examination on admission showed a large, muscular negro who was sweating profusely. His temperature was 100°; pulse, 76; respirations, 24; blood pressure, 124/80. Examination of the head, neck, and chest revealed no abnormalities. The upper part of the abdomen was tender. There was muscle spasm in the right upper quadrant and an easily palpable, round mass which descended on respiration from beneath the costal margin. This was acutely tender. The remainder of the abdominal examination was negative. The diaphragm was not elevated on either side. Urinalysis showed a large amount of sugar, acetone, and diacetic acid. Examination of the blood revealed: hemoglobin, 66 per cent; 18,760 leucocytes per cubic millimeter; 376 mg. per cent of glucose; carbon dioxide combining power, 51.3 volumes per cent; nonprotein-nitrogen 27 mg. per cent. Examination of the stool failed to show parasites or amoebae. X-rays of the chest and abdomen were read as normal. The admission diagnosis was liver abscess, probably amoebic, and diabetes mellitus.

The patient was immediately subjected to vigorous treatment for the control of the diabetes, and by the following morning his blood sugar had fallen to 251 mg. per cent and there was no acetone or diacetic acid in the urine. At the same time his temperature had risen to 104°. The abdominal mass was somewhat more tender and it was felt that this might represent an acutely inflamed gall bladder on the point of perforation. For this reason an emergency operation was decided upon. A laparotomy was done with local infiltration of procaine as the anesthetic agent. A right rectus incision was made directly over the mass. This mass proved

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to be the swollen, rounded edge of a greatly enlarged right lobe of the liver. The gall bladder, stomach, and other intra-abdominal viscera were all normal in appearance and on palpation. The surface of the liver was carefully palpated with the finger and no area of bulging or softening could be detected. There was one area about 2 cm. in diameter in the midportion of the right lobe which seemed to be exquisitely tender when palpated. This observation was verified several times. The patient who was, of course, quite conscious, was able to state that he had severe pain immediately when this area was palpated. It seemed likely, therefore, that the liver abscess might lie in this region. The general abdominal cavity was walled off with gauze packs. An aspirating needle was inserted into the liver. At a depth of about 3 cm. thick yellow pus was obtained. An incision was then made through the liver and an abscess cavity containing about 150 c.c. of yellow pus opened. Cultures were taken. One cigarette drain was inserted into this abscess cavity and a second drain placed along the edge of the liver in such a manner as to protect the general peritoneal cavity. The wound was then closed.

Direct smear and culture of the pus resulted in a pure growth of the gram-negative encapsulated bacillus of Friedländer. During the next seventy-two hours the patient's temperature varied between 100 and 102.8°. His diabetes was difficult to control; but, while there was still sugar in the urine, there was no acetone or diacetic acid. On the fourth day after operation, the administration of sulfapyridine was begun on the advice of Dr. Perrin Long. The patient was given 0.6 gm. every six hours by mouth. At this time the leucocyte count was 24,000. During the next twenty-four hours there was an immediate fall in temperature, the highest temperature being 100.4°, and from the fifth postoperative day onward the temperature never rose above normal. The drains were removed on the seventh postoperative day. Sulfapyridine therapy was discontinued on the thirteenth postoperative day. The hemoglobin at this time was 62 per cent and the leucocyte count was 7,550. On the nineteenth day after operation, cultures of the material draining from the wound were negative for Friedländer's bacillus, and the patient was permitted to get up. His diabetes was now well regulated by the administration of fifteen units of insulin daily.

He was discharged on Nov. 22, 1938. The diabetes was well regulated by diet, no insulin being necessary at this time. There was still slight discharge from the wound.

During the first week after leaving the hospital, the patient developed pain, swelling, and tenderness on the dorsum of the proximal phalanx of the left middle finger. This was incised by a physician elsewhere. The patient returned to this hospital on Nov. 29, one week after discharge. His temperature was 103°; the leucocyte count, 11,800. The chief observation of interest at this time was the edema, redness, and tenderness of the middle left finger and dorsum of the left hand. There was a draining wound on the dorsum of the proximal phalanx. His diabetes was again out of control and the blood sugar was 354 mg. per cent. It was felt that the finger infection was insufficiently drained. Under cyclopropane anesthesia incisions were made on either side of the middle finger, extending into the lumbrical canals and midpalmar space. A large quantity of yellow pus was obtained. The infectious agent on culture again proved to be Friedländer's bacillus. Sulfapyridine was again administered, and the diabetes brought under control by the use of fluids and insulin. The finger rapidly improved, and the patient was discharged on Dec. 15, 1938. At this time there was still a small draining wound on his finger, the swelling had diminished decidedly, and the diabetes was under control without insulin. The abdominal wound had ceased draining and was completely healed.

The patient was then followed in the Out-Patient Department. The finger did not heal. An x-ray taken on March 8, 1939, finally showed that there was chronic osteomyelitis with a large sequestrum in the proximal phalanx of the middle finger. This finger was amputated under cyclopropane anesthesia on March 31, 1939. The patient's last visit was on April 11, 1939, at which time the wound had healed and the patient was well.

There are several interesting points which I wish to make in connection with this case. In the first place, the observation of localized tenderness over a small intrahepatic abscess to my knowledge has not been described before. This observation can be made only when the operation is carried out under local infiltration anesthesia. Second, while numerous cases of liver abscess due to Friedländer's bacillus infection have been reported, the mortality has been high. It is a matter for speculation whether the successful outcome in this case was due to prompt surgical drainage, or sulfapyridine therapy, or both. Third, the high degree of infectivity of Friedländer's bacillus is worth remarking upon, so that such infections will be treated with proper respect. Not only did this patient develop a deep finger and hand infection, with loss of the finger, but also the house officer in charge of the patient developed a severe throat infection with Friedländer's bacillus. Following hospitalization and sulfapyridine therapy, his recovery was prompt and complete.

A CASE OF BILATERAL EXTRADURAL HEMORRHAGE

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ALTHOUGH the subject of epidural or extradural hemorrhage of traumatic origin and its surgical treatment is well known, the fact that the lesion may be bilateral is seldom mentioned and apparently of rather rare occurrence in the literature. LeCount and Appelbach[1] found in 504 post-mortem examinations of patients dying of head injuries, 104 extradural hemorrhages of sufficient size to cause compression of the brain and death; 1 of these was bilateral. Munroe[2] in 1935, discussing the treatment of head injuries, states that the lesion may be bilateral, but in his 22 cases of epidural hemorrhage there were apparently none that were bilateral. In a recent review of the subject Verbrugghen[3] does not mention the possibility. On the other hand, Pringle[4] had, in a series of 33 cases, 3 cases that at post mortem were found to have bilateral extradural hemorrhages of traumatic origin, an incidence of 10 per cent, which naturally brings up the question of whether the bilateral occurrence is as rare as it is generally thought to be. It is well known that bilateral subdural hematoma is of fairly frequent occurrence (Frazier[5]). Perhaps if looked for more often, bilateral extradural hemorrhage would be found more frequently. It is with this in mind that the following case is reported.

CASE REPORT

R. B., colored, male, aged 33 years, was admitted to the Harrisburg Polyclinic Hospital on Feb. 10, 1939, shortly before midnight. The history as obtained from his wife was that a few hours before he had come home complaining that he had been struck with a brick and within a short time had lapsed into coma. On examination he was found to be in deep coma. Temperature, 98° F.; pulse, 30; respirations, 10; systolic blood pressure, 200. There was a hematoma over the right forehead and blood coming from the nose. Otherwise he showed nothing else on physical examination. On neurologic examination he failed to react to any sort of painful stimulus. There was no deviation of the eyes, but the left pupil was larger than the right one. All four extremities were flaccid. None of the superficial or tendon reflexes could be obtained. There was no response to plantar stimulation.

He was taken to the operating room, where his head was shaved, cleaned with iodine and alcohol, and both sides draped. A trephine opening was made over the left temporal region. A clot approximately 4 cm. deep was encountered under the skull. The incision and bony opening were enlarged, whereupon the clot was found to extend anteriorly and upward to the midline. It was evacuated and the middle meningeal artery, which had been torn across, was thrombosed by electrocoagulation as well as some of its branches. The rest of the oozing was controlled with hot normal saline solution and cotton. The brain and its dural covering by this time had nearly filled the space occupied by the blood clot. The remaining defect was filled with normal saline solution and the wound was closed without drainage, using silk throughout.

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During the first twenty-four hours postoperatively, he responded fairly well and was able to take fluid by mouth. On examination he showed a third nerve palsy on the left side, although this pupil was smaller than before operation. In addition he had a left facial weakness of central type, weakness of the left arm and left leg with increased tendon reflexes on this side and a positive Babinski reflex. During the next twelve hours, he became more drowsy and his temperature rose to 102° F.; pulse, to 120; respirations, to 24. Tapping the wound failed to obtain either blood or fluid and one could feel a tense dura.

He was again taken to the operating room and under local anesthesia the right side of the head was prepared for operation. A trephine opening was made in the right temporal region and clotted blood was encountered under the bone. This opening was enlarged and a hematoma approximately 3 cm. deep was found to extend anteriorly and laterally over the frontal lobe to the midline as well as underneath this portion of the brain. The middle meningeal artery could be seen

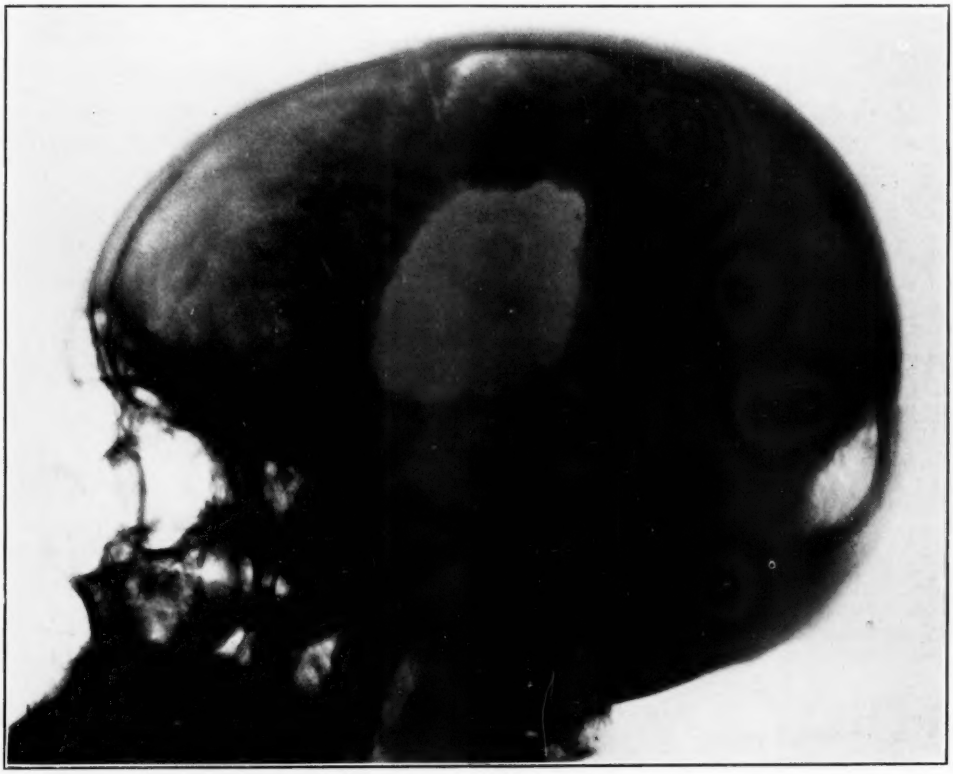

Fig. 1.—X-ray taken postoperatively, showing the bony openings. The larger of the two is on the right side where a decompression was made. Part of the line of fracture in the frontal bone can also be seen.

after evacuation of the clot. It had been torn at the foramen spinosum, but was not bleeding. The brain and dura expanded rapidly. In order to combat the cerebral edema, which was sure to follow, the dura was opened widely. Underneath the dura was a small clot which had arisen from a laceration near the tip of the temporal lobe. This clot was removed, bleeding points on the dura were cauterized, and the wound was closed without drainage with fine silk.

During the next twenty-four hours, he improved rapidly and responded well. The third day after this operation one could no longer detect weakness of the arm or leg and the Babinski sign was negative. The third nerve palsy was

greatly improved. He was discharged on Feb. 21, 1939, twelve days after admission. At this time his neurologic examination was normal. He was seen again two months later, at which time he was free of symptoms and no abnormalities were detected.

DISCUSSION

The diagnosis in this case could be made rather easily and with some degree of certainty from the history and the fact that the patient was deeply unconscious. The treatment followed was that advocated by Dandy.[6] Any temporizing as pointed out by Dandy in the way of x-rays, lumbar puncture, or intravenous hypertonic fluids undoubtedly would have cost this patient his life. Although both sides of the head had been draped in case a gross hemorrhage was not encountered on the left side (the left pupil was dilated), in retrospect it would have seemed better to have trephined the right side following the evacuation of the left hematoma, as the hemorrhage on this side could have been safely evacuated and arrested at that time. However, as the dura on the left side had not expanded to the skull, it seemed better at the time to let well enough alone. The subsequent development of a left hemiplegia, stupor, and a rising temperature made an exploration on the right side imperative at the end of thirty-six hours. Again, any other postoperative therapy in the way of dehydration or lumbar puncture would undoubtedly have done more harm than good. The small subdural clot found with the second hematoma was probably of little significance. A decompression was carried out in order to relieve any cerebral edema which seemed certain to follow the trauma and compression to which the brain had already been subjected.

In summary, a case of bilateral traumatic hemorrhage successfully treated by the operative removal and the arrest of the hemorrhage and by a right subtemporal decompression has been described. It is emphasized that procedures, such as lumbar puncture, intravenous therapy, and x-rays, in any case of suspected extradural hemorrhage may be not only actually harmful in themselves but are also frequently the cause of the loss of valuable time in the evacuation of the hematoma and the arrest of the hemorrhage.

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Editorial

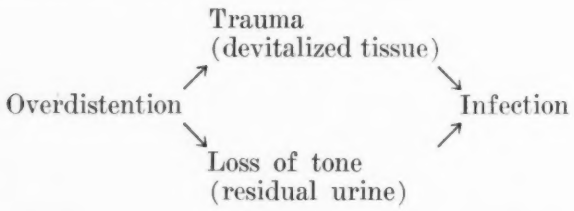
The Care of the Urinary Bladder After Operation

THERE is no organ in the body which so often plays the unhappy role of the innocent bystander who was accidentally injured as does the urinary bladder in the course of operations upon other unrelated organs. I refer, not to direct surgical trauma at the time of operation, but to the effects of neglected or mistreated postoperative retention of the urine. This complication is especially frequent after operations which confine the patient to bed. It is often described as "reflex," but it is actually due to a combination of three factors. First, many patients are unable to urinate in the horizontal position even when in good health. Second is the role of pain in patients with incisions in the abdominal wall or perineum. In such cases, contraction of the voluntary muscles of urination is painful, and hence more or less subconsciously avoided. Third is the effect of drugs. This may take the form of temporary residual paralysis after spinal anesthesia, but usually it is due to the administration of opiates which may tighten the internal sphincter or make the patient unaware of fullness of the bladder until it is overstretched; antispasmodics may lessen the contractility of the detrusor muscle, especially if opiates are given at the same time.

Some surgeons are loath to have their patients catheterized until prolonged, painful distention of the bladder has rendered the situation intolerable. They maintain that avoidance of catheterization is avoidance of infection and remain blissfully unaware of the havoc that prolonged painful distention of the bladder ordinarily produces, especially when supplemented by the patient's futile efforts to void. As Cabot long ago pointed out, prolonged distention of the bladder injures it and makes it a ready victim of infection. Experimentally,[1] such distention causes mucosal and submucosal hemorrhages and thus produces devitalized tissue which is an ideal culture medium for bacteria. Unfortunately, to this situation is added loss of tone by the detrusor as the direct result of the same injury. This has long been evident from the experience of patients with hitherto symptomless obstruction at the vesical neck who, either because of indulgence in alcohol or because of a long ride in an automobile, hold their urine too long, are then unable to let it go, and develop persistent retention. This crude clinical observation has recently been proved experimentally in a striking manner by Kirwin and Hawes. They had six ambulatory young men entirely free from lesions of the urinary tract hold their urine as long as possible. After they had finally voided, they were catheterized. All had residual urine, which

ranged from 70 to 365 c.c., with an average of 170 c.c. Remembering that these were robust, ambulatory men, it is easy to understand the frequency of urinary retention in sick postoperative patients who must void lying down despite painful incisions and the inhibitory effects of drugs.

The situation may be depicted thus:



This unfortunate situation is readily prevented (but much less readily cured once it has appeared) by proper attention to the bladder following operation. Account must be taken of the fluid intake. A patient who receives 3,000 c.c. of fluid per day will ordinarily put out at least one-half that same amount of urine. Since the average bladder will be painfully distended by about 500 c.c. of urine, the bladder must be emptied at least three, and often four, times daily to avoid overstretching. Also, fluids given intravenously may accumulate very rapidly in the bladder, at the rate of 500 c.c. an hour, or even more. Yet many a surgeon will order a liter of fluid intravenously immediately after operation, caution the house staff and nurses against catheterization unless absolutely unavoidable, and write an order to "catheterize every eight hours if necessary." An hour later the bladder is full; but, if the order is taken literally, seven hours will elapse before relief comes unless someone intervenes. Infection follows catheterization; the poor, innocent catheter (and the intern or nurse who wielded it) gets the blame which obviously attaches to the surgeon who, in the words of Cabot, "prepared the soil." Next time, he is even more determined to avoid catheterization.

Everyone is familiar with the dodges used to evoke urination, such as pouring warm water over the genitals or hand, applying a hot-water bag to the suprapubic area, running water within the patient's hearing, etc. These are not objectionable in themselves, and not infrequently are followed by micturition. They should be used only until distention becomes mildly uncomfortable without being painful, when a catheter should at once be employed. The gentle, aseptic passage of a small (No. 14 French), well-lubricated, soft rubber catheter does no harm unless the bladder has been previously damaged. If catheterization has to be repeated more than once or twice, the catheter should be tied in and connected through one arm of a sterile glass Y-tube and rubber tubing to a sterile reservoir hung at the bedside and containing sterile fluid (either water or a mild antiseptic); the other arm goes to a sterile

empty bottle beneath the bed. Thus the bladder is kept empty, avoiding both trauma and stagnation of urine, and it can be irrigated by releasing a clamp. This obviates the contamination which is inevitably introduced from without when unsterile equipment is used or when the catheter is irrigated by hand by any but the most skilled assistants. Stalker and Schulte have recently shown that infection with the inlying catheter in postoperative patients may be obviated in one-half and minimized in the other half of patients with inlying catheters by giving 5 gr. of sulfanilamide three times daily, producing a concentration of 25 mg. of sulfanilamide per 100 c.c. of urine.

Many surgeons will follow such a regime only to undo its good effects by premature removal of the catheter, or by forgetting the bladder as soon as the catheter is out. It should be left in place until the patient is gaining strength and is able to move about freely in bed. After the catheter has been removed, the residual urine should be measured in ten to twelve hours, or less if the patient experiences any discomfort, since overdistention of the bladder may prove troublesome even at this time. If the residual exceeds 75 to 100 c.c. or if urination is difficult, the catheter should be reinserted and removed every day until residual urine is absent and urination is easy.

If the bladder is emptied completely and spontaneously, the residual should again be measured in twenty-four hours to make certain that the ability to empty it has been retained. This is especially important in the elderly male who may have had a low-grade obstruction at the vesical neck with neither palpable enlargement of the prostate nor symptoms; this situation occurs not infrequently with contracture of the vesical neck or enlargement of the median lobe when the detrusor is hypertrophied. Such a patient may respond to any stress or strain with a retention of urine which, if at all neglected, will become permanent and necessitate operation.

A few patients who do not empty the bladder completely after removal of the catheter may be aided to do so by the administration of pilocarpine or mecholyl (to stimulate the detrusor through the parasympathetics) and by being taught to void as much as possible, rest a moment or two, and then repeat the effort one or more times.

If residual urine persists despite these measures after the patient is out of bed, cystoscopy is clearly indicated to determine the cause. It should be done by one qualified to recognize minor obstructions in either sex.

The regime outlined above is a simple one, but its meticulous application will save both patient and surgeon a very great deal of worry and discomfort and will shorten many a convalescence. As much more could be said about the management of neurogenic vesical dysfunction (or cord bladder if you prefer). Suffice it to say here that, in those dysfunctions due to injury of the spinal cord, an attempt should be made

first to empty the bladder by the Credé maneuver sufficiently often to prevent overdistention. If this fails or is impractical, an inlying catheter with an irrigator, such as that of Munro and Hahn, permitting tidal irrigation, should be used, since this is a very satisfactory means of minimizing or preventing damage to the urinary tract. If, after improvement of the spinal cord is complete, it becomes evident that the innervation of the bladder is permanently destroyed, cystostomy should be done, since it is much easier to maintain than an inlying catheter and is free from the risk of periurethritis, prostatitis, and epididymitis. Should recovery of the cord then occur unexpectedly, the bladder has been preserved intact and will resume its function if the tube is removed.

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Recent Advances in Surgery

CONDUCTED BY ALFRED BLALOCK, M.D.

THE SURGICAL TREATMENT OF GASTRIC AND DUODENAL ULCER

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WHILE there has been little recent advance in determining the cause of ulcer of the stomach or duodenum, there has developed during the last few years a better correlation of medical and surgical thought resulting in a more uniform treatment of the disease. Close cooperation now exists among internist, surgeon, and roentgenologist, both for diagnosis as well as treatment and subsequent care of the patient.

In contrast to fifteen years ago when over one-half of the patients with ulcer were treated by surgical measures, surgery is now confined to those instances in which complications occur during medical treatment. This then limits the number of surgically treated cases to 5 to 10 per cent of duodenal ulcers and approximately 20 per cent of gastric ulcers.[3, 126] With improving methods of medical treatment, such as aluminum hydroxide therapy, the number of patients requiring surgery may be even further decreased.

At present it is generally agreed that the indications for surgery in the treatment of ulcer should be limited to perforation, pyloric obstruction, certain instances of profuse hemorrhage, intractable pain not controlled by medical treatment, and a suspicion of malignancy. Although these general indications are widely accepted, there is still a diversity of opinion as to the type of operation which should be carried out and, except for perforation, the time when it should be performed. An attempt will be made to summarize the trend of surgical opinion over the five-year period, 1934-1938, in regard to the treatment of gastric and duodenal ulcers by reviewing the various methods of surgical treatment employed and by evaluating their results.

PERFORATION

There is usually little difficulty in the diagnosis of acute perforation. To the classical symptoms of acute epigastric pain, boardlike rigidity, localized epigastric tenderness with the usual concomitant general symptoms, such as increased pulse rate, nausea, perhaps vomiting, etc., may be added the obliteration of liver dullness due to free gas under the diaphragm and referred shoulder girdle pain from stimulation of the

phrenic nerve. Helpful diagnostic information may also be obtained by a roentgenogram taken with the patient upright to demonstrate free air under the diaphragm. S. E. Johnson in this way found evidence of pneumoperitoneum in 83 per cent of forty-two cases. Paine and Rigler have demonstrated from experimental observations that as little as 5 c.c. of air within the peritoneal cavity can be shown by x-ray. It should be remembered, however, that pneumoperitoneum does not always occur and therefore the surgeon should not necessarily refrain from operating in its absence. Moreover, unless a roentgenogram can be taken immediately, operation should not be delayed to prove or disprove the presence of a pneumoperitoneum, since it has been so clearly shown that the mortality rate rises in almost direct proportion to the length of time elapsing between perforation and time of closure. Singer has described the syndrome of intermittent perforation.

Perforation occurs most frequently in men between 30 and 50 years of age.[27] However, all ages from infancy to 82 years are recorded in the literature, the latter being a case of perforated gastric ulcer reported by Sandell. The preponderance of perforations occurring in males is further emphasized by the report of Eliason and Ebeling of seventy-four perforations in which only one occurred in a woman.

Probstein, Gray, and Wheeler observe a high diastase in those occasional ulcers which perforate posteriorly into the pancreas. From this they conclude that a low diastase determination rules out acute pancreatitis as well as a perforation involving the pancreas as the cause of the acute abdominal symptoms.

The preoperative preparation of the patient is often as important as the technical steps of closure, especially in late perforation. As for any acute abdominal emergency, the fluid balance must be properly adjusted by the administration of parenteral saline and dextrose given preferably by vein. Also, it is desirable to insert a nasal tube and institute constant gastric suction as soon as possible. This empties the stomach and prevents or limits the further escape of gastric or duodenal contents into the peritoneal cavity until the perforation is closed. Moreover, vomiting during or after operation is avoided by maintaining the suction until the edema about the pylorus has subsided and patency is re-established. The use of constant gastric suction is probably the most important addition to the treatment of gastric cases in the last five years.

Nisbet calls attention to Baker's suggestion of administering methylene blue by mouth just before operation. Two or three ounces of a 2 per cent methylene blue solution are given orally after the preoperative medication and before the patient enters the operating room. The escape of the dye through the perforation aids, he believes, in its localization, thereby saving time and eliminating a good deal of manipulation. At the same time it helps to define the size of the perforation. Moreover in some instances the staining by the dye may settle the question as to whether or not the hole has already been sufficiently well sealed off.

There is no general agreement as to the type of anesthesia which should be used or to the superiority of any one type. However, local infiltration anesthesia is usually unsatisfactory because of the general distress of the patient and the marked abdominal rigidity. It is our custom to administer nitrous oxide-oxygen and ether. Fallis favors spinal anesthesia because he found a greatly reduced mortality rate in a series of cases in which spinal anesthesia was used in contrast to a second group in which general anesthesia was used. But each surgeon should use the anesthesia to which he is most accustomed.

Perforation is the one complication of gastric or duodenal ulcer in which immediate surgery is unquestioned. There are, however, various opinions concerning the technique of closing the perforation, the inclusion of additional surgical procedures, and the advisability of drainage.

A variety of incisions has been advocated for exposure of an acute perforation. Amendola describes an easy approach, a small incision starting about one inch below the xiphoid and extending downward parallel to the costal margin for a distance of about three and one-half inches. He cites the several advantages of this exposure to be as follows: straining under anesthesia does not interfere with the exposure; bleeding is minimal; greater exposure can easily be obtained by extension at either end; direct exposure of the site of perforation is attained in about 95 per cent of the cases, about the proportion which occurs in the first part of the duodenum on its anterior-superior surface; subsequent hernia is less likely because the liver protects the undersurface of the wound; this small incision can be easily closed and another made if the diagnosis should prove incorrect; the incidence of pulmonary complications is reduced because full respiratory excursion can be made without pain; and finally, it is possible to get patients out of bed sooner than the use of the usual liberal midline or right rectus incision permits. Although the approach described by Amendola is satisfactory, the incision must be large enough to permit adequate inspection of the duodenum and stomach to rule out the possibility of a second perforation. Regardless of how obvious the perforation may be, James and Matheson have emphasized the possibility of a coexistent second perforation. Schilling, of Oslo, advocates a primary incision in the right iliac fossa as well as the usual incision for closure of the perforation. A lavage is carried out through both incisions followed by closure without drainage. With this procedure he is able to report a mortality rate of 2.8 per cent where operation is performed within six hours of the time of perforation and 7.4 per cent when performed within twelve hours. The general adoption of this procedure would seem undesirable since its use might cause a spread of infection.

To prove the presence of air within the peritoneal cavity, it is helpful to fill the wound with saline solution and note the presence of air bubbles at the time of opening the peritoneal cavity. There is general agreement in the literature that as much as possible of the intraperitoneal fluid and

particles of food should be removed by aspiration. It is desirable, moreover, to avoid injuring the already insulted serosa by the introduction of too many packs into the peritoneal cavity.

A wide diversity of opinion exists as to the proper management of the perforation itself. The majority of surgeons believe that the less done the better and that no more than simple closure of the perforation should be carried out. The recent literature clearly indicates that in the past there has been too much fear of obstructing the pylorus following closure alone. With the use of constant gastric suction it is now apparent that troublesome acute postoperative obstruction of the pylorus is infrequently encountered despite the fact that at the time of operation the duodenum may appear to be occluded. Graham[36] prefers to close the perforation with three chromic catgut sutures, one introduced at its upper margin, one in the middle, and one at the lower margin. These are tied loosely over a tag of omentum or a free omental graft. The use of omentum in sealing off the perforation has been widely adopted. Gatch and Owen advocate an excellent method of closure, using normal flexible gastric and duodenal wall well beyond the site of induration. They recommend that several silk sutures be introduced into the gastric wall about one or two inches proximal to the pylorus and well distal to the ulcer in the duodenum, where a firm hold can be obtained in relatively normal intestinal muscularis. None of the sutures is tied until all have been properly placed. The suture line must seal off both above and below the point of perforation, and in addition the omentum may be anchored up over the suture line. It is not necessary to close the perforation with two or three layers of sutures. However, this method cannot be used to close perforations complicated by supraduodenal abscesses. Despite the fact that this technique would appear to occlude the duodenum completely, such has not been proved to be the case. In only one patient in twenty was it necessary to perform a posterior gastroenterostomy later.

The general opinion in this country is that in the great majority of cases the addition of any procedure to that of simple closure in the long run will raise the mortality rate. Certain foreign surgeons, however, advocate radical resection for perforation. Judin, of Russia, for example, recommends resection in young persons and employs conservative operations only in the elderly or in those with advanced peritonitis. The Billroth I type of resection is usually the choice, with a few instances of the Polya-Balfour type of gastrojejunal anastomosis. He reports 331 resections for perforated ulcer, with a mortality of 7.8 per cent. It is often difficult to evaluate many of these mortality figures because only in the good risk patient with a very short duration of perforation are the more radical procedures done. Other sporadic reports advocate resection for perforation. For a time at the Peter Bent Brigham Hospital this principle was tried, but it was soon found that the mortality rate did not justify the procedure. Furthermore, a simple pylorectomy or Billroth I

resection may be a poor choice of operation because it does not guarantee the patient against recurrent ulceration of the duodenum.

Opinion concerning the advisability of drainage following closure of the perforation is about equally divided. There are those on the one hand who believe drainage is a lifesaving procedure and those on the other who believe that it not only is unnecessary but adds definitely to the mortality rate. Eliason and North, for example, advocate drainage routinely at the site of perforation. They bring the drain out through a stab wound and place a second drain laterally between the liver and diaphragm if there is contamination at this site. In addition a suprapubic drain may be inserted. It is their impression that the lives saved by drainage outweigh the damage it may do. They were able to grow bacteria in 80 per cent of the cases in which a culture was taken. Fallis likewise recommends routine drainage since the principal cause of death from perforation is peritonitis, and believes that it may be a lifesaving procedure. Morrison advocates drainage and employed it in 178 out of 200 cases. On the other hand, McCreery, Sallick, Trout, and others believe that drainage is unnecessary. Certainly this problem cannot be solved by an analysis of the mortality figures of the two schools of thought, since in each instance these range from approximately 10 to 22 per cent. It would seem that drainage may be safely omitted in early perforation when there is little evidence of gross contamination of the peritoneal cavity. Drainage is advisable in late perforation or in the presence of extensive soiling from the escape of gastrointestinal contents into the peritoneal cavity.

The management of late cases of perforation demands special attention. Occasionally in patients in extremely poor condition who seek relief twenty-four or more hours after perforation, better results may be obtained by attempting to restore electrolyte balance and by maintaining constant gastric suction. Under this treatment the perforation may seal off and recovery may follow despite what at first appeared to be a hopeless outlook.

From a series of experiments in animals Bergh, Bowers, and Wangensteen are able to show a mortality rate of 86.7 per cent from peritonitis when a stomach containing food is perforated compared to 6.9 per cent for an empty stomach. These experimental observations are consistent with the clinical findings. Furthermore, they report a mortality of 81.2 per cent for experimental perforation of the duodenum in fasting animals in contrast to only 6.9 per cent mortality for similar gastric perforations. Since few organisms are present in the duodenum of fasting animals, the high mortality must be associated with injurious effects produced by bile and pancreatic juice. This confirms the finding of Blalock that gastric juice is less harmful than duodenal juice. He finds in studying the effect of the escape of large amounts of bile, pancreatic, gastric, and duodenal juices into the

peritoneal cavity that infected pancreatic juice or a mixture of bile and pancreatic juice is more lethal than any single juice, particularly if it is sterile.

The late results following operation for perforation are reported by various authors. Cable finds only 19.5 per cent of the cases which could be classed as good or excellent six months to three and one-half years after simple closure. Lewisohn[69] reports a recurrence of symptoms in 39 per cent of his cases and emphasizes the apparent fallacy of the rather widespread belief that perforation cures the ulcer. Guthrie and Sharer, however, find that 95 per cent of their cases followed after simple closure of a perforation remained well, and they believe that perforation acts to some extent like cauterization. Eliason and Thigpen find 86.4 per cent symptom free after simple closure and 76.2 per cent after closure and posterior gastroenterostomy.

In the Peter Bent Brigham Hospital the patients with perforated ulcer receive strict medical treatment after operation and are maintained on this regimen for an indefinite period. It is indeed dangerous to imply to a patient that, since perforation has occurred, there is little need to worry about subsequent trouble from the ulcer.

HEMORRHAGE

The treatment of the complication of hemorrhage is far from uniform in regard to the advisability of surgery, the type of surgical procedure, and the best time for its performance. Goldman[34] and others emphasize the fact that too many physicians believe gross hemorrhage from an ulcer is rarely fatal and adopt a policy of watchful waiting. The danger inherent in this point of view is demonstrated by the mortality of 15 per cent in his series of 349 cases. Jankelson and Segal report a mortality of 10.5 per cent in 200 massive hemorrhages. It is apparent from a study of the literature that a definite percentage, ranging from 5 to 15 per cent, of cases of massive hemorrhage associated with ulcer terminates fatally in the hospital.

Various methods of medical treatment are recommended, usually based on bed rest, starvation, and sedation. However, Meulengracht advocates early feeding and on this basis reports the low mortality of 1.3 per cent in 368 consecutive cases. Satisfactory results are reported following the administration of aluminum hydroxide by nasal tube, as described by Woldman. However, it is too early to evaluate the effectiveness of the Meulengracht diet or the aluminum hydroxide method in lowering the number of bleeding cases which require surgery.

Schindler believes that gross hemorrhage is one of the most important indications for gastroscopy. As soon as possible after the patient has recovered sufficiently, x-ray examination and gastroscopy should be carried out. By gastroscopy the source of the hemorrhage may be revealed, such as that from tiny hemorrhagic erosions, small ulcerations in hypertrophic ulcerative gastritis, and similar lesions which are not shown by

x-ray. Benedict also emphasizes the value of gastroscopy in many cases of gastrointestinal hemorrhage.

Surgeons writing on the problem of the treatment of gastric or duodenal hemorrhage from ulcer invariably make a plea that they be consulted early and that the responsibility of deciding upon surgical therapy be divided equally between the surgeon and internist at the onset of the hemorrhage. By such cooperation it is hoped that a better decision as to the time for surgery, if it is indicated, can be made and that surgery will not be considered a final gesture to be employed only after the failure of medical treatment.

It has been repeatedly emphasized that surgery as a late treatment for the exsanguinated patient carries a high mortality, usually more than 30 per cent.[29] In the Peter Bent Brigham Hospital, Emery and Monroe conclude that the late results of surgical procedures in the treatment of hemorrhage are about the same as those following exacting medical treatment. They find the incidence of hemorrhage after all types of operations for a variety of indications, including hemorrhage, to be 17.4 per cent as compared to 19.3 per cent for a similar group after medical treatment alone.

Many writers point out that the mortality rate from bleeding is very low in youth and early middle age, but that it rises abruptly after the age of 45 years. Jankelson and Segal report a mortality rate of 5 per cent below the age of 40 years and 15 per cent above that age. Allen[2] states that duodenal ulcer treated conservatively rarely causes fatal bleeding under 50 years of age, but at the Massachusetts General Hospital there was a mortality of 33 per cent in patients over 50. Consequently, the teaching is becoming more widespread that bleeding from gastric or duodenal ulcer in patients beyond middle age is a much more serious complication than it is in the younger group and that early surgery must be considered if the inevitable high mortality rate is to be lowered.

That there exists an optimum time for surgery after the onset of bleeding and that surgery delayed beyond this point will result in a much higher mortality rate, regardless of the amount of blood given by transfusion, seems well established.[29] In patients seen forty-eight hours or longer after the initial massive hemorrhage, it is well to delay operation until recovery is complete. Massive gastric hemorrhage is not uncommon in women with an acute lesion of the mucous membrane, but unless there has been a previous history of ulcer, surgery is withheld. In young persons surgery may be withheld to see if, under medical treatment, the ulcer crater will entirely heal and the patient will remain symptom free. Otherwise, resection is, as a rule, wise after the patient has recovered from the acute blood loss. Surgery is indicated in patients having recurrent hemorrhage on adequate medical treatment regardless of age, since it has been emphasized that there is an abrupt rise in mortality following the second hemorrhage.[33]

In the preparation of these patients for surgery, adequate blood should be available for transfusion. As much as 3,600 c.c. of blood has been given by the drip method over a period of five days previous to the time of resection.[43] It is generally accepted that intravenous fluid should not be given because of the danger of increasing the blood pressure and initiating further bleeding. Such fluid as is necessary, other than blood, is given by hypodermoclysis to be taken up as needed. Blood transfusions should be given following the fall of the blood pressure to at least 70 mm. of mercury. There is no evidence that the giving of calcium and the various thromboplastic substances has any effect on the hemorrhage.

A Levine tube may be passed into the stomach by the nasal route, and the stomach may be emptied of its contents. Some believe that this is dangerous and may initiate further bleeding; also that the administration of epinephrine or astringents by stomach tube is without effect when the hemorrhage is severe.[33] The proponents of constant gastric suction believe that by aspirating saliva, gastric juice, and blood clot the stomach is put at rest, and that the strain of vomiting with possible renewal of hemorrhage is avoided. Should bleeding recur, it can be quickly detected by aspiration of the stomach contents and appropriate treatment can be carried out. It is advisable to leave this tube in place during operation and the early postoperative period.

The recent surgical literature tends to discredit posterior gastroenterostomy in the treatment of the bleeding case, although Walters[114] states that gastroenterostomy will protect the patient against recurrence of hemorrhage in 82 per cent of the cases, and, should hemorrhage recur, it is seldom of serious import. Westermann reports seventeen patients with bleeding ulcer on whom a gastroenterostomy was performed and who later developed recurrent hemorrhage. Lewisohn[68] believes that a posterior gastroenterostomy is absolutely futile in bleeding gastroduodenal ulcers. Hinton[44] states that thirteen of the 123 bleeding ulcer patients seen at Bellevue Hospital had a previous posterior gastroenterostomy. Many others believe that posterior gastroenterostomy does not protect the bleeding case permanently from a recurrent hemorrhage. According to Goldman,[34] thirty patients in his series had gross hemorrhage from an ulcer after gastroenterostomy. He advocates removal of the ulcer in addition to a subtotal gastrectomy after the method of Allen and Benedict.

With gastroenterostomy generally accepted as inadequate in the treatment of hemorrhage, there has been a trend toward radical gastric resection after the teaching of Finsterer. Finsterer[29] reports a mortality of 4.3 per cent for early resection in massive hemorrhage. However, this figure jumps to 32.7 per cent when operation is delayed by a trial of medical treatment. He insists that surgical therapy should be instituted within forty-eight hours of the initial massive hemorrhage.

About the same results are reported for the exclusion operation as for

gastroenterostomy. Allen[2] reports disappointing results in fifteen patients in whom the antrum was transected and a posterior gastroenterostomy was carried out. This type of procedure he abandoned in favor of radical resection with removal of one-third to two-thirds of the distal portion of the stomach as well as the ulcer-bearing portion of the duodenum when possible. He has carried out this operation without a fatality in thirty-eight consecutive cases of posterior wall duodenal ulcer with satisfactory results at the time of reporting.

Allen[2] also re-emphasizes the procedure previously described by him and Benedict for the operative removal of a posterior penetrating ulcer which is actually bleeding. He calls attention to the anastomotic blood supply involving the gastroduodenal artery, a vessel which is frequently involved in the massive hemorrhage. Since the gastroduodenal artery communicates with the pancreaticoduodenal and gastroepiploic arteries, it is necessary to ligate all three to control massive hemorrhage safely in the posterior penetrating ulcer. The stomach is divided between crushing clamps at the desired level, and the pylorus is reflected to the right, exposing the posterior surface of the duodenum, to obtain a good view of the area of erosion of the ulcer into the pancreas. When the patient is actually bleeding, the distal portion of the stomach is opened on its anterior surface between long clamps exposing the ulcer and permitting the surgeon to introduce his index finger into it for immediate control of the bleeding. If preferred, the ulcer may be packed, and the pack may be held in place by an assistant during the subsequent steps of the operation. This provides an opportunity for the surgeon to visualize adequately the papilla of Vater. The vessels entering the inflamed area are then ligated after careful consideration of the anastomotic blood supply. When the ulcer has eroded deeply into the pancreatic tissues, no effort is made to remove or cauterize the involved portion of the pancreas. The duodenal wall is freed beyond the point of ulceration, and the stump is closed in the usual fashion. In those instances in which the ulceration is so low on the duodenum that closure in the usual fashion might obstruct the papilla of Vater, the duodenum may be safely closed by approximating the serous coat of its anterior wall to the capsule of the pancreas. Another method of closure utilizes the remaining antrum which has been denuded of its mucosa. The approximated walls of the antrum cover the ulcerated area as well as close the duodenum. A Polya type of gastrojejunostomy is then carried out. Stab wound drainage may be instituted to the subhepatic space if the surgeon thinks there may have been injury to an accessory pancreatic duct.

Pfeiffer[88, 89] emphasizes the principle that the primary consideration at the time of surgery for bleeding ulcer is hemostasis, and not necessarily that of curing the ulcer. He advocates a gastroduodenotomy, which provides adequate exposure of the bleeding point. The point is then sealed off with a coagulating electrode or an encircling suture of chromic catgut placed through the tissues above and below. The overhanging edges of the ulcer may be mobilized and brought together with

sutures. Small radiating incisions may be of advantage in instances of large excavated ulcer. This, he believes, is not as shocking a procedure as resection and offers a low mortality rate with a good chance of cure. Moreover, it presents no handicap to radical resection should such become necessary later. Lahey and Marshall advise the use of four crossed mattress sutures of silk passed through the periphery of the ulcer which, when tied, control the bleeding. They prefer silk to catgut sutures because of the danger of digestion of the catgut resulting in recurrent bleeding. Many, however, believe it is unwise to risk the control of a bleeding point to transfixing sutures of chromic catgut or silk passed through the bed of the ulcer. Hinton[45] points out that the eroded artery may be anywhere from one-half to three-fourths of an inch from the duodenal wall. Accordingly, the sutures applied to control the bleeding in the bed of the ulcer of necessity must be applied rather deeply and blindly.

The consensus of opinion then in the treatment of bleeding duodenal ulcer is to control the bleeding point in the poor risk patient and to keep in mind that hemostasis and not necessarily the permanent cure of the ulcer is the immediate goal. However, whenever the general condition of the patient permits, a sufficient amount of the stomach may be removed to reduce the secretion of acid as well as to remove the ulcer-bearing area. Following this some type of gastrojejunal anastomosis is carried out. Ligation of the coronary arteries alone is considered insufficient to control the bleeding. Because of the danger of malignancy in gastric ulcer, excision of a liberal edge is advocated not only to control the bleeding but to permit adequate microscopic examination. Even the opponents of gastroenterostomy in the treatment of duodenal ulcer believe that it may have a place in the treatment of gastric ulcer.

OBSTRUCTION

Gastric retention as the result of edema, hypertrophy, spasm, or scarring of the pylorus is a common complication of both gastric and duodenal ulcers. Kruse finds 51 per cent of ulcers showing some obstructive characteristics. Despite its clinical frequency, Monroe and Emery find that obstruction as a complication of ulcer causes less than one-twentieth of the deaths in comparison with perforation which causes one-third and hemorrhage, one-fourth. In 120 cases with ulcer Portis and Jaffe report stenosis the principal lesion at necropsy in 11.6 per cent of ulcers of the stomach and 4.2 per cent of ulcers of the duodenum.

It is emphasized that gastric ulcer some distance from the pylorus may produce pyloric spasm with gastric retention and may make it difficult for the roentgenologist to distinguish between gastric and duodenal ulcer. A retention of 100 per cent at one examination is not an indication for surgery. It has been pointed out by Emery and Monroe and others that the great majority of such patients if put on strict medical treatment con-

sisting of alkaline therapy, antispasmodics, and aspiration will recover without surgery. It is only when retention of 40 per cent persists or recurs on adequate medical treatment that surgery is recommended.[126] In the presence of obstruction it is important that the surgeon take into consideration the adequacy of the previous medical treatment and make certain that the retention is a result of scarring or hypertrophy of the pylorus with impaired motor function. Persistent or recurrent obstruction is, therefore, a definite indication for surgery.

The ulcer patient with pyloric obstruction must be carefully prepared for surgery. These patients are usually undernourished, with imbalance of their electrolytes, vitamins, and protein metabolism. In addition, the dilated stomach may present many technical obstacles to surgery. McNealy and Lichtenstein point out that suturing may be difficult in the thickened, edematous walls of the stomach in these patients. Not only may the ordinary anatomical relations be so disturbed that the stoma may be incorrectly placed, but the outlet may be reduced markedly in size when the elongated fibers of the stomach have had an opportunity to shorten after operation. They recommend that, after the stomach has been washed out to remove undigested food, the patient be placed on constant gastric suction with a modified Wangensteen apparatus and that a so-called pyloric balance chart be maintained. This balance chart is designed to indicate the ability of the stomach to empty its contents into the duodenum. A negative balance implies that the amount of gastric contents which can be aspirated exceeds the amount given by mouth, and a positive pyloric balance that the amount of gastric contents which can be aspirated is less than the amount given by mouth. In the presence of a positive balance it may be assumed that the stomach is able to evacuate some of its contents. This method is employed in cases of malignant obstruction as well, and in these cases 60 to 80 minims of dilute hydrochloric acid are administered three times a day. Special attention should be given to the patient with obstruction suffering from alkalosis and nitrogen retention. The use of aluminum hydroxide in lieu of the usual Sippy powders should avoid this complication and better prepare the patient for surgery. If the serum protein levels are lowered, a transfusion should be given preoperatively. Electrolytic balance is maintained by the intravenous administration of 5 per cent dextrose in isotonic saline solution. Gastric lavage is carried out the night before and the morning of operation, and the patient is maintained on constant gastric suction during and after the operation.

The most enthusiastic supporters of radical resection agree that posterior gastroenterostomy has a major place in the treatment of pyloric obstruction, but even here the operation should be limited to those patients with definite scarring of the pylorus, impaired motor function, and low acid values. Such patients are usually middle-aged or elderly. However, gastroenterostomy should not be carried out in young persons or in those with high acid values. Newburger reports that gastroenter-

ostomies performed in patients below the age of 30 years are usually failures. Marshall and Kiefer believe that gastroenterostomy has a place in the treatment of obstruction because of its low mortality rate and the smooth convalescence it affords patients past middle age who have low acid values and considerable cicatrical pyloric obstruction. Nicolaysen states that gastroenterostomy should be the method of choice in patients 45 years of age and older and that further it is indicated in pyloric stenosis with large retention and induration of the stomach irrespective of the age. Others are not in accord with the use of short-circuiting procedures regardless of the age of the patient, believing that it is dangerous in the young because of recurrent jejunal ulceration. Crile and Crile, Jr., report that 87.5 per cent of the patients having gastroenterostomy for obstruction are relieved of their symptoms as compared to only 60 per cent of twenty cases for pain. Graham[35] points out that in the presence of obstruction surgery should not be carried out until a gastric analysis has been done in order to determine the proper operative procedure. He favors gastroenterostomy for patients with a scarred pylorus and low hydrochloric acid values and for elderly patients with penetrating, nonstenosing ulcers without obstruction but with low free acid values. All other patients should be submitted to subtotal gastrectomy. Eggers finds that 90 per cent of his patients having a gastroenterostomy are relieved and that the mortality is 4.1 per cent; Truesdale that 18 per cent are not relieved and in 185 cases the mortality is 4.9 per cent. Graham[35] reports 89 gastroenterostomies with a mortality of 3.4 per cent; Allen and Welch 101 with a mortality of 7.9 per cent. These reports no doubt include many cases where the indication for surgery was one of the commonly accepted complications other than pyloric obstruction.

A reduction in the gastric acidity following posterior gastroenterostomy has been shown by Walters[115] to occur in 30 to 50 per cent of the cases. This is in contrast to the observation made by Holman and Sandusky, who found that the acid was not altered in 92 per cent of seventy-five patients and that the postoperative titratable acidity could not be used as the prognostic criterion of the results. Tomoda and Aramaki find that there was no uniformity in the acidity in thirty-two cases of gastroenterostomy, and conclude that the determination of the acid values alone in the stomach which has been operated upon is worthless in estimating the success or failure of a given operation.

Certain technical details of gastroenterostomy were recently emphasized. Kogut and Stein report two cases of gastroileostomy which promptly developed severe symptoms. This can be avoided by a clear visualization of the ligament of Treitz just before the jejunal loop is brought up to the stomach. Lahey and Swinton emphasize that in making a gastroenterostomy the opening in the mesocolon should be as far away from the transverse colon as possible and near the ligament of

Treitz to avoid the possibility of a gastrojejunocolic fistula if ulceration should occur postoperatively. McCaughan and Coughlin stress the importance of making the opening in the mesocolon to the left of the middle colic artery to avoid obstruction between it and the superior mesenteric vessels. When the stomach is dilated, the loop of jejunum must be longer than usual and the stoma must be made larger to insure satisfactory function upon the return of the stomach to a normal size.

The Finney pyloroplasty is used by Graham[38] occasionally as well as posterior gastroenterostomy. He also uses the Finney pyloroplasty in elderly patients if there is pyloric stenosis, low free hydrochloric acid, and no massive hematemesis. From his experiments Dragstedt concludes that gastroduodenostomy with a large stoma or pyloroplasty is preferable to gastrojejunostomy in the presence of retention. Clute and Sprague advocate gastroduodenostomy for the relief of pyloric stenosis and report seven satisfactory cases. They describe the technical steps of properly freeing the lateral wall of the duodenum to avoid postoperative obstruction from rotation of the duodenal loop.

One of the major problems in the treatment of pyloric obstruction from ulcer is to determine when surgery is advisable. It is generally agreed that immediate surgery should not be recommended initially even if the patient's symptoms and x-ray findings indicate complete pyloric obstruction, because remarkable improvement and frequent avoidance of surgery may follow gastric lavage and nightly aspiration, bed rest, and strict medical management. At the end of this period of treatment, even if the obstruction is not overcome, the patient is a much better risk for surgery, due to the restoration of proteins, vitamins, and calories and the equalization of the electrolytic balance. If troublesome obstruction persists, it is generally agreed that gastroenterostomy is the ideal type of operation except in young persons or in those with high acid values. Gastroenterostomy may also be advisable when technical difficulties prevent resection or when the patient is a very poor risk. A discussion of the end results of gastroenterostomy is included under the heading of jejunal ulcer.

INTRACTABLE TO ADEQUATE MEDICAL TREATMENT

This comprises a large miscellaneous group of patients who continue to have pain or discomfort despite adequate medical therapy. It is assumed that these patients are the severe clinical types which have failed to respond to an ideal form of medical treatment. They frequently have high acid values, or may be classed as cases of hypersecretion. It is in this group that the argument of conservative versus radical operative procedures is most heated. In fact there are as many able opponents for conservative measures, such as posterior gastroenterostomy, as for radical subtotal resection, making it difficult in reviewing the literature to evaluate or understand such extreme divergence in surgical opinion. It is apparent that the surgeon must be prepared to carry out a variety of

operations in the treatment of the ulcer depending upon the individual case. All too frequently in the reviewer's opinion there is a tendency to fall into the routine of a particular operation without sufficient consideration of the various factors involved. There is too great a tendency to be always radical or always conservative without suitable application of the various technical procedures available.

In skilled hands the mortality rate of resection has been markedly reduced and in recent years more nearly approaches that of posterior gastroenterostomy. Graham[35] reports a mortality in 140 subtotal gastrectomies of 3.8 per cent; Finsterer, a mortality in 920 resections for duodenal ulcer of 3.4 per cent with 94.6 per cent reported as cured; Cutler, a mortality of 9.3 per cent for resection with 3 per cent poor results; Lahey and Marshall, 130 subtotal gastrectomies with a mortality of 18 per cent and evidence of recurrent jejunal ulcer in 7 per cent. The majority of the reports include both gastric and duodenal ulcer.

But before any type of operation for gastric resection is attempted, the patient should receive adequate preoperative preparation. This may be varied somewhat depending upon the nutrition of the patient and the degree of pyloric obstruction. The factor of marked retention has been discussed under gastroenterostomy, with special reference to the pyloric balance sheet. Cutler and Zollinger advocate the substitution of a high caloric diet for the rigid ulcer regimen as a preparation for the postoperative period of limited caloric intake. But should the nutrition of the patient be seriously impaired, a jejunostomy for feeding purposes may be indicated before the primary gastric operation. Studley reports the interesting observation that, if patients lose 29 per cent of their preoperative weight, there is a postoperative mortality of 33 per cent in contrast to a mortality of 3.5 per cent in those patients who lose less weight and are in better general condition prior to operation. Since wound healing is encouraged by the administration of adequate amounts of vitamin C, patients receiving modern medical therapy should have proper vitamin replacement during their preoperative treatment. It is well established that free hydrochloric acid in the gastric juice has a sterilizing effect on the stomach contents with a lower incidence of postoperative infection. Moreover, it has been shown that this beneficial sterilizing effect is present even in the presence of low free acid values.[102] Alkaline therapy, therefore, may be withheld a few days before operation to permit sterilizing of the gastric contents by the return of high acid values.[72] In cases of preoperative hemorrhage, secondary anemia, or when an extensive procedure is anticipated, such as a radical resection, donors should be available for transfusion. The high incidence of pulmonary complications associated with upper abdominal surgery makes it imperative that elective gastric operations be carried out in a normal range of vital capacity and in the absence of respiratory infection.

The immediate preoperative care involves gastric lavage with a large caliber tube until clear fluid is returned. This is repeated on the morning of operation. When a high resection is anticipated, the Levine tube may be left in place to permit removal of gastric secretions during the progress of the operation, thus lessening the chance of soiling the field when the anastomosis is carried out. Fluid balance is corrected by the subcutaneous or intravenous administration of 5 per cent dextrose in isotonic saline solution if there has been retention. Otherwise the patient is encouraged to drink as much fluid as possible the day and night before operation. Some surgeons prefer to administer 500 c.c. of citrated blood during operation.

Various types of anesthesia are recommended. In the poor risk patient novocaine infiltration anesthesia fortified with a sufficient preliminary dosage of a suitable sedative is advisable. Finsterer prefers a supplementary splanchnic infiltration as well. Spinal anesthesia is finding greater favor in this country, especially with the use of drugs giving a prolonged effect. Sise believes that in most instances spinal anesthesia with nupercaine or pontocaine is satisfactory. The proper selection of anesthesia, he believes, plays a vital role in lowering the mortality rate. He reports a marked reduction of the mortality rate for gastric resection for ulcer when nupercaine spinal anesthesia is used: nupercaine spinal, 8.4 per cent mortality; combined anesthetics, intratracheal, 15.4 per cent; novocaine spinal and ether, 25 per cent. Nitrous oxide-oxygen and ether administered by an intratracheal method are also advocated. The intratracheal method is indicated especially for very high resections involving manipulation about the esophagus. In each instance the choice of the anesthesia must depend upon the condition of the individual patient and the surgeon's personal experience with the facilities at his command.

Each of the various types and methods of resection has its advocates. Gastroduodenostomy after the Billroth I method would appear to be the most physiologic type of operation. Experimental evidence supports this view. Horsley[49] prefers this operation with anastomosis of the duodenum to the lesser curvature. In performing this resection he does not hesitate to incise the anterior wall of the duodenum to enlarge its lumen and facilitate end-to-end anastomosis with the stomach. Jaeger also believes the Billroth I is the procedure of choice over gastroenterostomy. Jonsson finds the late results of Billroth I operation satisfactory in 94.5 per cent of his cases. Von Haberer advocates the use of the Billroth I procedure, and Steinberg recommends its use under certain conditions. Others have pointed out that the Billroth I operation has only a limited use and that it is followed by a high incidence of recurrent duodenal ulceration.[37] A recent review of a series of Billroth I operations at the Peter Bent Brigham Hospital shows this high incidence of recurrent duodenal ulceration, and for that reason the operation is no longer advocated in that clinic. Walters[115] believes that recurrence of

ulceration after the Billroth I operation is much greater than after the Polya resection, even when the antrum has been removed. However, the Billroth I operation may be used if there is anacidity or very low acid values; otherwise some modification of the Billroth II operation, such as the Polya, may be used, although the Finsterer-Hofmeister modification is gaining more and more in general use.

There has been very little actual improvement in the technical steps of carrying out gastric resection. Lahey[7] and Marshall endorse the use of the dePetz sewing clamp, and Graham,[37] of Toronto, and others use the Schoemaker clamp. Clute has devised a modification of the Furniss clamp which permits it to be inserted from either side, simplifying insertion of the pin and closure of the duodenal stump.

There appears to be a tendency to use a long loop of jejunum brought up anterior to the transverse colon. Since experimental evidence shows a decreased resistance to hydrochloric acid from the duodenum downward, the incidence of jejunal ulceration should increase when long jejunal loops are used in the anastomosis. If an anterior loop is used, an enteroenterostomy should not be done because of the high incidence of recurrent gastrojejunal ulceration. Some prefer to make a retrocolic, isoperistaltic anastomosis.[124] Connell recommends a V-shaped excision of a large portion of the fundus to decrease the acid-bearing surface. Cutler and Zollinger recommend an all-silk technique for gastric resection. Schindler, on the other hand, has recorded that, whenever a silk suture is found hanging free in the gastric cavity by gastroscopy, reoperation is indicated because of the associated recurrent ulceration and adjacent gastritis. Paolucci refutes this in a group of experiments on dogs, concluding that there is no relation between postoperative duodenal ulcer and a silk thread suture. Lahey[62] also in writing on jejunal ulcer states that linen or silk is not the true offender but is merely an innocent bystander in the formation of jejunal ulceration.

The number of patients requiring subtotal gastrectomy because of failure to respond to adequate medical treatment is gradually decreasing. This is due not only to improvement in the medical treatment afforded the patient with ulcer but to recognition of the fact that subtotal resection is not as effective in preventing subsequent difficulties as was originally hoped. Furthermore, late results from the more conservative surgical measures, such as gastroenterostomy, are satisfactory in the experience of many. The surgeon should not rigidly adhere to any one type of surgical procedure but should let his choice depend upon the history and general condition of the patient, the laboratory findings, and the findings at the time of operation. If he deems resection advisable, he should not be content with less than radical removal of a large portion of the acid-bearing surface of the stomach. However, the surgeon must have sufficient experience to be reasonably assured that the mortality rate from resection will not be far above that of a more

conservative procedure. Radical resection should not be attempted in poor risk patients or where technical difficulties make it hazardous. It is generally agreed that even after a radical resection the patient must follow a careful medical regimen for an indefinite period.

GASTRIC ULCER

Although a far greater number of patients suffer from duodenal ulcer than from gastric ulcer, the percentage of the latter group coming to surgery is much higher. This is due to the fact that the problem in the treatment of gastric ulcer is to rule out the possibility of malignancy and to make certain that early eradication is undertaken if the location or progress of the lesion is suspicious; while, in the satisfactory treatment of duodenal ulcer, the problem is one of control of the acid factor.

There has long been argument as to whether gastric ulcers undergo malignant change. Hinton and Trubek are of the opinion that once a gastric ulcer always a gastric ulcer, although it may be difficult to tell the difference between a benign lesion and an early ulcerating carcinoma. It is their opinion that there is no conclusive evidence that gastric ulcer is a forerunner of gastric carcinoma. In contrast Chang believes that 5 per cent of gastric ulcers show malignant change, and Howze believes that cancer develops in about 10 per cent of all cases of gastric ulcer. Dible places the incidence of carcinoma at 5 to 6 per cent; Ransom, at 5 per cent; von Haberer, at about 9 per cent. On the other hand, Klein believes that if malignant degeneration occurs at all it is extremely rare and that this possibility is an insufficient indication for early radical surgery and removal of a gastric ulcer. Indeed the mortality rate from promiscuous gastric resection would be far greater than that from malignancy. Bloomfield believes that the only practical attitude to adopt is to regard small, apparently innocent gastric ulcers as benign until evidence to the contrary is weighty enough to arouse suspicion and to accept the fact that a certain number of unavoidable tragedies will occur. It is impossible to determine by clinical observation the early malignant changes in an apparently benign gastric ulcer. However, Schindler, in observing 66 patients with gastric ulcer by gastroscopy, was able to differentiate between benign and malignant ulcers of the lesser curvature and determine the source of hemorrhage, and thus to give invaluable aid to the clinician. In studying a large number of perforations associated with carcinoma, McNealy and Hedin suggest biopsy of the gastric perforation, believing that in this way an early case of carcinoma occasionally may be encountered.

The surgeon should be influenced by the location of the gastric ulcer because of the frequency of malignancy in certain areas. Gastric ulcers within one inch of the pylorus should be considered malignant until proved otherwise. Early surgery should be advised or rigid medical

treatment with frequent roentgenologic examinations for an indefinite period regardless of apparent early clinical improvement. Very large ulcerations or ulcerations on the greater curvature should also be considered malignant. Scott urges that all gastric ulcers be resected which do not respond, under strict medical management, by diminution of symptoms the first week, complete disappearance of symptoms and absence of occult blood in stools the second week, and disappearance of the filling defect by fluoroscopy by the end of the third week. Walters[118] advocates surgery for gastric ulcer in patients who have had a hemorrhage when the x-ray shows a crater, when the lesion is producing pyloric obstruction, and when the ulcer is near the pylorus or on the greater curvature. The remaining indications for surgery are similar to those of duodenal ulcer; namely, perforation, persistent pain, obstruction, bleeding which does not respond to medical treatment, and stricture or hourglass contraction.

Once surgery is decided upon for gastric ulcer there is some difference of opinion as to the proper technical procedures to carry out. Balfour believes that excision and gastroenterostomy are ideal for the small gastric ulcer. It is his opinion that gastroenterostomy will heal gastric ulcers provided that there is no malignant change. Jejunal ulceration is not great after surgery for gastric ulcer, and there is a greater incidence of achlorhydria following operation for gastric ulcer than for duodenal ulcer. Walker believes that gastrojejunostomy for high gastric ulcer does not give good results. He prefers a Polya-Moynihan type of resection leaving the ulcer in situ. Segal and Scott also prefer the Polya-Moynihan type of resection which they carried out in thirty-four cases with relief in 82 per cent and a mortality of 11.8 per cent. The mortality in twenty-three cases operated upon by the senior author was only 4.3 per cent. It is their opinion that gastroenterostomy with local excision may give a low mortality, but that the morbidity is high, the total relief low, and the recurrence of malignancy when present almost invariable. Sénèque believes that gastrectomy instead of gastroenterostomy should be carried out for ulcers of the lesser curvature because of the danger of hemorrhage, the persistence of pain, and the possibility of neoplasm. Roholm and others find that a sleeve resection is unsatisfactory because of the frequent recurrence of an ulcer along the suture line. This seems to be a generally accepted observation. Finsterer[28] favors resection for gastric ulcer and found microscopic evidence of carcinoma in 23.1 per cent of the specimens removed. Ninety-five and eight-tenths per cent of his gastric ulcers were cured by resection. Walters[117] reports that a Billroth I or Polya type of resection, provided a mortality as low as 3 to 4 per cent can be shown, is indicated for large gastric ulcers, but that there is a place for destruction of the ulcer by cautery or segmental resection combined with gastroenterostomy. He reports that, following a Billroth I or Polya operation for gastric ulcer, there is a relative achlorhydria. Friedemann, out

of 207 patients subjected to Billroth I operation ten to seventeen years previously, finds 73 per cent good results, 20 per cent fair results, and 7 per cent poor results; for the Billroth II operation, 76 per cent good results, 15 per cent fair results, and 5 per cent poor results. In his series the Billroth II operation gives slightly better results. He mentions, however, that at that period he did not remove as much stomach as is now advocated or the results might have been much better.

Horsley[50] reports ulcers occurring directly on the pyloric sphincter, a location present only in about 3 to 4 per cent of the cases of gastric ulcer. On these twelve cases a Billroth I type of operation was carried out in all instances.

It is apparent that every gastric ulcer should be considered potentially malignant regardless of the age of the patient, the findings by gastric analysis, or early clinical improvement. All patients with gastric ulcer must be subjected to strict medical management and frequent x-ray examination for an indefinite period until all symptoms and roentgenologic evidence entirely disappear. Large ulcerations, ulcers within one inch of the pylorus, those on the greater curvature, and those which do not respond to three or four weeks of medical treatment should be subjected to operation, together with those which perforate or bleed profusely. Small and benign appearing lesions may be excised and gastroenterostomy carried out. Billroth I resection is satisfactory for the small prepyloric lesion. However, if the indication for surgery is the possible chance that the ulcer is malignant, it is far safer to carry out a radical resection with removal of the regional lymph glands. The gastric ulcer, therefore, demands rigorous supervision with close cooperation among internist, roentgenologist, and surgeon.

JEJUNAL ULCER

Postoperative jejunal ulceration following gastroenterostomy or some type of Billroth II operation is an all too frequent complication of gastric surgery. It has been repeatedly emphasized in the literature that the best treatment of this serious complication is its prevention by more careful evaluation of the acid values and by more judicious selection of the initial operation. The incidence of jejunal ulceration is reported as from 2 to 24 per cent in patients having a gastroenterostomy.[65] Those in favor of conservative surgical treatment of gastric ulcer by the more general use of gastroenterostomy usually report an incidence of jejunal ulceration in patients observed after gastroenterostomy in the neighborhood of 3 per cent;[57, 116, 120] those in favor of radical treatment by resection usually report a much higher incidence. In the British Isles, Wright, in a collective inquiry into 2,734 patients having a gastroenterostomy, finds an incidence of jejunal ulcer in 8.49 per cent. Means believes that the occurrence of jejunal ulceration following gastroenterostomy is probably around 15 per cent, while Marshall and Kiefer are of

the opinion that it is nearer 24 per cent. Hinton and Church find 16.4 per cent and Newburger 9.7 per cent. Von Haberer regards the appearance of jejunal ulcer as so frequent after posterior gastroenterostomy the opinion that it is nearer 24 per cent; Hinton and Church find 16.4 that he thinks this operation should be considered a palliative procedure only.

Jejunal ulceration follows the exclusion operations probably next in frequency to gastroenterostomy. Allen[2] carried out this procedure in fifteen cases and gave it up because of unsatisfactory results. A high incidence of jejunal ulceration is likely to occur with a long loop anterior gastroenterostomy, and when an enteroenterostomy has been performed in association with a gastrojejunostomy.

Jejunal ulceration is not uncommon after inadequate resection and gastrojejunal anastomosis. The incidence of jejunal ulceration following resection is reported as 0.4 to 10 per cent.[65] Lahey and Marshall report recurrent ulceration after subtotal gastrectomy in 7 per cent of their cases; Cutler, in 3 per cent; Lake, in less than 2 per cent. Lahey and Swinton report in their series that 90 per cent of the original ulcers were duodenal and only 10 per cent gastric. Wright reports that jejunal ulceration did not develop in any of 436 cases following resection for gastric carcinoma. Although of rare occurrence, jejunal ulceration has been recorded following gastric resection for carcinoma.[95]

Judd and Hoerner report that 50 per cent of jejunal ulcerations occur within a year and 34 per cent occur within six months of the time of the primary operation. Grossman reports the occurrence of jejunal ulcers from twelve to eighteen years after the original operation, with seven of the twenty-three cases appearing after a lapse of five years. The location of the ulcer is recorded by Balfour[5] as marginal in 75 per cent of his cases and on the jejunum itself in 25 per cent. Lahey and Swinton report similar figures.

The treatment of jejunal ulcer is both medical and surgical. Many cases with marginal ulceration following short-circuiting operations, although obstinate, can be entirely cured by adequate medical treatment. However, medical treatment may fail to relieve the patient; there may be a free perforation, or the very unfortunate complication of a gastrojejunocolic fistula may occur. Makkas, in reviewing 131 cases of jejunal ulcer which penetrated into the peritoneal cavity, finds that jejunal ulcers perforate less often than gastrojejunal; that simple perforation usually results in a re-formation of the ulcer with a mortality of approximately 23 per cent; and that there was a mortality of 8.3 per cent in 24 cases treated radically. Judd and Hoerner in 597 cases of jejunal ulcer find a tendency toward perforation in 43 per cent.

There is some variety of opinion in regard to the surgical treatment of the jejunal ulcer which does not respond to medical treatment. Judd and Hoerner believe that the logical operation is taking down the gastro-

jejunal anastomosis and restoring normal continuity by a Billroth I type of operation. Additional partial gastrectomy is indicated in some of these patients. They find, however, that only 6 per cent of the 597 cases treated required a second operation regardless of the nature or extent of the primary surgical treatment of the jejunal lesion. Many believe that it is dangerous to restore normal continuity after jejunal ulceration lest there be a prompt return of the original ulcerative lesion. Lahey and Swinton, for instance, report 40 per cent recurrent duodenal ulcers in ten patients having restoration to normal continuity after resection of the jejunal ulcer. Ginzburg and Mage, in studying eighty-six resected specimens of postoperative jejunal ulceration, conclude that while a mechanically efficient stoma tends to bring about the healing of an active duodenal ulcer, it seems to favor development of an anastomotic ulcer; and disconnection of the gastroenterostomy stoma because of anastomotic ulceration may result in reactivation of latent duodenal ulcers. For these reasons some type of resection is advocated. Bohmansson advises a Billroth I operation as a routine treatment and has a mortality of 4 per cent in such cases without acute complication. Graham and Lewis recommend a block resection of the stomach and jejunum with an end-to-end anastomosis of the jejunum and either a Billroth I or retrocolic Polya reconstruction of gastric continuity as the ideal procedure. The operative correction of a jejunal ulcer carries a rather high mortality. Finsterer in 168 operations for jejunal ulcer reports a mortality of 11.3 per cent and Ogilvie, a mortality of 19 per cent.

It would appear that when surgery is carried out for jejunal ulcer an extensive gastric resection should be considered in an effort to control adequately the acid factor.

GASTROJEJUNOCOLIC FISTULA

Gastrojejunocolic fistula is a serious complication of jejunal ulcer. In an effort to avoid this complication, if possible, Lahey and Swinton urge that, if a gastroenterostomy is to be carried out, it should be done at a point in the transverse mesocolon away from the transverse colon.

Rife reports fourteen cases of gastrojejunocolic fistula appearing in a period of six months to eleven years after gastroenterostomy for ulcer. For thirteen cases arising from ulcer there was a mortality of 20 per cent. Lahey and Swinton say that symptoms may occur from a few weeks to twenty-one years, but about 50 per cent of the gastrojejunocolic fistulas occur within two years of the original operation. They report a mortality of 63 per cent in nine cases, eight of which were operated upon. At the Massachusetts General Hospital, Allen[1] reports the incidence of postoperative gastrojejunocolic fistula as approximately 14 per cent, the mortality in ten cases being 30 per cent.

Graham and Lewis consider that the ideal operation for gastrojejunocolic fistula is block resection of the stomach, jejunum, and colon with

triple anastomoses together with a cecostomy. Scrimger reports a method of dividing the stomach above the opening in the jejunum. A cuff of stomach is cut one and one-half inches from the edge of the stoma, and its mucosa is dissected off the muscularis down to the edge of the ulcer until the stomach mucosa is removed. The stoma is then closed by suturing together the inner surfaces of the stomach cuff. The operation is completed by a gastroenterostomy. But within two years the patient had a recurrence of jejunal ulcer. Another suggestion[65] is that the stomach be divided above the fistula and that the remaining portions be anastomosed with the jejunum. After a period of three to four weeks, when the patient has recovered, the remainder of the stomach is resected along with the fistula and the right colon. Allen[1] reports a technique of aseptic repair of a gastrojejunocolic fistula. A pair of long, thin Kocher clamps is applied about the stomach side of the stoma, and this wedge-shaped section of gastric wall is freed with a cautery. The stomach is closed following the Kerr aseptic technique. Clamps are then applied to permit removal of a wedge-shaped part of the hypertrophied involved jejunum. It also is closed using the aseptic technique. The involved portion of the transverse colon is resected as well with end-to-end anastomosis, following here again the Kerr aseptic technique.

Of course the subsequent problem in the management of the gastrojejunocolic fistula is the maintenance of strict medical supervision to avoid reactivation of a jejunal or duodenal ulcer, depending upon whether or not normal continuity was established or some type of short-circuiting procedure was carried out.

POSTOPERATIVE CARE

The immediate postoperative care of these patients concerns the avoidance of shock and pulmonary complications. The usual precautions of frequent change of position and hyperventilation are followed. Marshall advocates the use of oxygen tents after prolonged gastric operations. Aspiration through a bronchoscope may relieve postoperative atelectasis. The fluid balance is maintained by the intravenous or subcutaneous administration of 5 per cent dextrose in amounts up to 3,000 c.c. a day. Water in sips is allowed after twenty-four hours. Constant gastric suction is started through the Levine tube which many prefer to leave in place during the operation. If edema develops, sodium chloride and serum protein determinations should be made, distilled water substituted for saline solution, and a low protein level raised by transfusion. The diet is very slowly increased following the classification of foods permitted under the early Sippy regimen. No solid food is given until the fourteenth or fifteenth day.[121] Should there be a tendency to vomit, constant gastric suction is resumed and maintained for as long as is necessary.

It is all too frequently assumed by physician, surgeon, and patient as well that surgical treatment of the ulcer insures against subsequent difficulty. But, if the best results are to be obtained, a careful medical regimen must be continued for an indefinite period.

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Review of Recent Meetings

REVIEW OF THE SOUTHERN SURGICAL ASSOCIATION MEETING, DEC. 5, 6, 7, 1939, AUGUSTA, GA.

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THE annual meeting of the Southern Surgical Association was held Dec. 5, 6, 7, at the Forest Hills Hotel in Augusta, Ga. Of a total of forty listed papers, thirty-six were presented.

1. **C. C. Coleman,** Richmond, Va., discussed the results of faciohypoglossal anastomosis in the treatment of facial paralysis. Whereas most cranial nerve operations are destructive, facial nerve operations are reparative and are intended to effect restoration of nerve and muscle function. Neither direct anastomosis nor nerve graft is likely to result in the desired restoration of function because of the extension of wrong fibers along the distal axis cylinders. Anastomosis with another nerve is better, preferably the hypoglossal. The loquacious person is the most undesirable type of individual for operation, because emotional expressions associated with rapid talking result in poor functional results. The author called attention to the fact that misdirection of axis cylinders is likely to result in mass action of facial muscles. He advises that the patient repress emotional expressions. Attempts to educate individual muscle groups following anastomosis are likely to result in worse functional results, such as undesirable grimaces. Anastomosis following angle tumor removals should be done within three weeks. Implantation of fascial strips as a supplement to the nerve operation may be necessary in order to prevent muscular atrophy. When the muscle does not respond to galvanic stimulation, then nerve operation is of no value. The atrophy of the tongue which follows hypoglossal nerve section is of no serious importance.

In the discussion of this paper, **Charles Bagley,** Baltimore, Md., was in accord with Dr. Coleman in respect to early repair when it is known that the nerve has been injured during angle tumor removals. Muscular atrophy is thereby minimized. **Joseph E. J. King,** New York, N. Y., favors reanastomosis for those cases of facial nerve injury which follow mastoid operations; individual nerve anastomosis when peripheral injury of the nerve has occurred; and hypoglossal anastomosis in cases of intracranial destruction of the facial nerve. **Frank H. Lahey,** Boston, Mass., advocated using the spinal accessory nerve if foreign nerve anastomosis is necessary. He feels that the loss of speech and swallowing is more undesirable than loss of arm function, which follows use of the spinal accessory nerve. **Vilray P. Blair,** St. Louis, Mo., stated that, in cases of old nerve injury or in those cases in which nerve injury has occurred within the parotid, the difficulty and futility of nerve operations make them impractical. He recommends fascial transplantation as a very satisfactory procedure under such circumstances.

In closing, Dr. Coleman agreed that nerve grafts avert the associated movements which occur when the tongue is used after hypoglossal nerve anastomosis. The question concerning the advantages of using the spinal accessory nerve rather than the hypoglossal nerve will always be a debatable one. Voice records showed no speech disturbances in his cases. Stylohyoid and digastric muscle injuries

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and slow regeneration of the buccinator muscle function are responsible for any speech disturbances which occur following faciohypoglossal anastomosis.

2. **Waltman Walters,** Rochester, Minn., in a presentation concerning **Operative and Postoperative Infections With Special Reference to Air-Borne Bacterial Contaminations,** affirmed the ideas of Bergmann. He discussed the factors which contribute to wound infection; i.e., rough handling, poor hemostasis. Dr. Walters reviewed the sources of infection: (1) Nose and throat of the operating team personnel. Elimination of carriers and wearing of a germ-proof mask will prevent hemolytic streptococcus infections. Masks transmit more bacteria when moist than when dry. Hart and Schiebel found a parallel between the organisms in the operating-room air and those in the noses and throats of the occupants of the operating room. (2) Hands of operating personnel. Mr. E. A. Devenish and Professor Miles, of England, found that punctured gloves were responsible for staphylococcus infections. (3) From the patient's skin. No thoroughly reliable skin antiseptic exists but the tincture of merthiolate is the best antiseptic at present available, based upon Petri dish culture studies on different antiseptics.

Precautions should be taken to purify the air of the operating room. The room and furniture should be properly cleaned and the door kept closed. Velocity of outside wind is important and precautionary measures should be taken to prevent the entrance of dust into the operating room, which increases the agar plate count. The count rises when the operating room is occupied by the surgical team and observers, so a canopy over the instrument table is desirable. According to Devenish and Miles, contamination of wounds by air-borne organisms is slight. A high *Staphylococcus aureus* infestation does not necessarily imply a high incidence of infection. Wound infection varies with geographical location. The protection which a coating of serum affords bacteria, and the undesirable effect of grease on the glass of the ultraviolet lamp were discussed. Efforts should be made first to eliminate other sources of infection before turning to air sterilization.

3. **Daniel C. Elkin,** Atlanta, Ga., discussed **Wound Infection: A Comparison of Silk and Catgut Sutures.** Wound-healing results are an index of a surgeon's ability and his surgical philosophy. Dr. Elkin classified wounds into the following groups: (1) clean, (2) potentially infected (hematoma with positive culture), and (3) infected. Fibroplasia occurs sooner in wounds closed with silk than in those closed with catgut. The liquid which accumulates in wounds closed with catgut acts as a favorable culture medium. Statistics show a lower incidence of wound infection in cases in which silk was used; i.e., 2.1 per cent compared to 9.4 per cent when catgut was used. In 188 potentially infected wounds in which silk was used, there were 7.7 per cent infections; in 312 potentially infected wounds in which catgut was used, there were 21.4 per cent infections.

4. **Frederick A. Coller,** Ann Arbor, Mich., discussed the delayed closure of contaminated wounds. About 50 per cent of wounds contaminated with gastrointestinal contents develop serious infection. He suggests packing the subcutaneous portion of the wound with flavine gauze after introducing sutures through the peritoneum and transversalis fascia. Twenty-four to forty-eight hours later, sutures, which previously have been introduced for mass approximation of the muscles or abdominal wall, are drawn taut. In a series of 22 cases in which this method was used, minor infection occurred in 2 cases and serious infection developed in only 1 case. All others healed with no infection. Bacteriologic studies were made before and after closure of the wound in 15 cases and it was found that after twenty-four hours the cultures were the same. Dr. Coller agreed with Behanes that the irritation produced by the gauze causes an inflammatory reaction which is effective as a bacteriostatic mechanism or factor. Sulfanilamide or scrubbing the wound before closure had not been tried.

In discussing the preceding three papers, **Deryl Hart,** Durham, N. C., agreed that all precautions should be taken to avert wound infection, but he insisted that air contamination is a most important factor and one which has long been neglected. Statistics show marked reduction of infection in Duke Hospital during a period in which radiation has been used. Radiation is used usually in large, primary, clean operations. **Roy D. McClure,** Detroit, Mich., asked if anaerobic cultures had been made by Dr. Coller and he wondered if aerobic conditions established by Dr. Coller's procedure were not responsible for the good results. **Hugh A. Gamble,** Greenville, Miss., cited an Austrian surgeon who permitted no talking in the operating room but used sign language instead. In his own clinic Gamble has followed the same practice and he gave a demonstration of the signs he uses. He called attention to the fact that some years ago he advocated leaving open potentially infected wounds. Gamble believes that a medicated pack acts beneficially in three ways: (1) by causing reversal of the flow of lymph, (2) by preventing inflammatory reaction, and (3) through the antiseptic substance in the gauze. **Frank K. Boland,** Atlanta, Ga., asked if cultures of catgut had been made in Dr. Elkin's cases and inquired about the relative cost of silk and catgut. **Frederic W. Bancroft,** New York, N. Y., believes that there is still another source of wound contamination and cited the obtaining of 72 per cent positive cultures from peritoneal cavity in so-called "clean cases." **William H. Prioleau,** Charleston, S. C., reported that he has been very satisfied with the results he has obtained with very fine chromic catgut. He abandoned the use of silk because, in his experience, its use was associated with an increased number of draining wounds. He believes that a fine alloy wire is superior to silk. **W. A. Bryan,** Nashville, Tenn., discussed the greater susceptibility to infection of dead, traumatized, and ischemic tissues. He emphasized that small caliber of the suture material, the tying less tightly of sutures, and the avoidance of the strangulation of large amounts of tissue are of extreme importance in wound healing. **Charles C. Green,** Houston, Tex., reported that he had obtained better results with fine chromic catgut than he had in 100 control cases in which silk was used. **Rudolph Matas,** New Orleans, La., described the revolutionary mode of treatment of wounds which he observed being practiced by military surgeons with the Republican forces in the recent Spanish Civil War. He compared the attempts to reduce bacterial contamination to a minimum as spoken of in previous papers read at this meeting with what he saw in Spain, especially in the management of compound fractures of the femur. In many instances cleansing was done in a very superficial way. Débridement was done as carefully as the conditions at the time permitted. No irrigations were done. Packs of vaseline gauze were introduced when possible; otherwise, plain sterile gauze packs were used. All wounds were left open. To assure absolute rest, casts were applied from the waist down. No antiseptics were used and it was impossible to keep up the Carrel-Dakin technique. The comparative absence of gas and tetanus infections was amazing, and, unless the temperature rose to a high level, the wounds were not opened for two to three weeks. The number of streptococcus infections was extremely low, although saprophytic infection was high. When the odor became unbearable, the cast was removed, the wound just wiped off, and the cast reapplied. Dr. Matas cited the use by a Frenchman of a helmet into which air was introduced through a tube in order to accomplish complete avoidance of air contamination.

In closing, Dr. Elkin stated that the use of catgut met with the requirements as set up by Dr. Meleney. In closing, Dr. Coller agreed that exposure of the wound to air might be an important factor in the good results obtained by delayed closure of wounds.

5. **Hugh H. Trout,** Roanoke, Va., in discussing the role of x-radiation in the treatment of carcinoma of the breast, said that there is no substitute for the radical operation for carcinoma of the breast. Radiation is not so well standardized at present as is surgery, thus accounting for the confusion regarding interpretation of radiation results. His opinion is based on 600 cases of carcinoma of the breast, a consideration of the literature, and conferences with radiologists. Preoperative radiation which destroys tissue is undesirable and increases the chance of recurrence. Appropriate dosage should be estimated to meet individual requirements. Young women can receive three or four times as much radiation as can older women, so the former get better results. Radiation at short intervals is more desirable in younger women because of more rapid cell division in this type of patient. As emphasized by Coutard, it is important to study the life cycle of carcinoma in the individual patient. He cited the difficulties encountered in his clinic in carrying out prolonged preoperative radiation, and in many cases forty-eight-hour preoperative radiation was employed. Preoperative radiation is valuable in the presence of palpable axillary glands, infiltration of the skin, debilitated patients, rapidly growing tumors associated with pregnancy, apparently hopeless cases, and carcinoma implantation in tract of biopsy needle. Radium is administered at the time of operation by introducing fifteen or twenty radium needles of 3 to 5 mg. each. Postoperative radiation is started after ten days; if begun earlier, the graft will be killed. Through public education, cases are being brought in earlier and this accounts, at least in part, for improved results. Relief of pain can be accomplished by means of x-radiation in some cases. Dr. Trout also spoke of radiation of the pelvis and suggested that the good effects of radiation in carcinoma of the cervix may be due in part to the simultaneous irradiation of the ovaries.

6. **Barney Brooks,** Nashville, Tenn., in a discussion of the present status of the radical operation for carcinoma of the breast, quoted statistics and cited observations of others to the effect that local removal or simple mammectomy, combined with radiation, or the use of radiation alone, is equally good or superior to the radical Halstead operation. He gave the principles underlying the radical operation, notably the removal in mass of all tissue which might be involved, regardless of concepts concerning the mode of extension of carcinoma; i.e., whether by continuity or by embolism. Dr. Brooks cited the remarkable similarity of the original publications by Halsted and by Meyer concerning the treatment of carcinoma of the breast. The findings at the time of operation are of more prognostic value than is histologic classification. The radical operation is the procedure of choice.

In discussing the last paper, **Roy D. McClure,** Detroit, Mich., felt that many surgeons who say that they perform the Halstead operation are not, in reality, employing the technique advocated by Dr. Halstead, as this type of operation frequently necessitates large grafts. Dr. McClure referred to an apparatus devised recently which greatly facilitates obtaining large sheets of skin for grafting purposes.

Charles C. Lund, Boston, Mass., classified the inoperable cases of carcinoma of the breast into cases: with growths fixed to chest wall, with bone and chest metastasis, and with marked edema of the skin. In 40 per cent of instances enlarged lymph glands are not recognized at the time of operation. Pathologic reports confirm the findings in 90 per cent of cases of carcinoma of the breast in which glands are felt. Lund is not now employing radiation of the pelvis as an adjunct in the treatment of carcinoma of the breast. He does not at present administer preoperative radiation, but postoperative radiation is employed more extensively than formerly. **Rollin A. Daniel,** Nashville, Tenn., presented ad-

ditional data regarding patients referred to by Dr. Brooks. He discussed the average duration of life after the tumor is first noticed by the patient and the comparative results whether or not x-ray is employed. **Walter O. Bullock,** Lexington, Ky., in discussing Dr. Trout's paper, deprecated radiation of the pelvis and inadequate breast operations. **James F. Mitchell,** Washington, D. C., stated that Bloodgood carried the operation even further than Halstead. **L. Wallace Frank,** Louisville, Ky., reported that, in 192 cases of carcinoma of the breast, he had only 3 skin recurrences. In his experience, Dr. Frank stated that skin grafting following radical breast operations has not been necessary.

In closing, Dr. Trout stated that radiation is likely to cause carelessness in surgical removal. He has treated some cases which at first appeared inoperable, but which, following radiation, became operable. Better results have been obtained when there is a single large axillary mass than when there are many small shotty ones. He is presently not enthusiastic about radiation of the pelvis. Dr. Brooks, in closing, said that he believes that operative treatment is on trial for its life. Before condemning it, one must be certain that it has been carried out properly. However, the validity of the basis for the radical operation has been reasonably questioned, and reinvestigation of the problem is, he believes, in order.

7. **J. M. Donald,** Birmingham, Ala., reported 21 cases of scalenus anticus syndrome, 5 of which had an associated cervical rib. In many instances the patient did not have a long neck. In operative procedure for this condition, the thoracic duct may be lacerated. Bilateral tenotomy was performed in 3 cases with a bilateral scalenus anticus syndrome. One case had preoperative gangrene with atrophy of muscles of the arm and shoulder. A section of muscle was removed in some cases. Of 16 cases submitted to operation, 14 were relieved. Some cases were immediately relieved, and the longest time elapsed before relief was obtained was six weeks. Dr. Donald cited 19 cases in which only mild symptoms were found and which needed no operation. The scalenus anticus syndrome is more common than most surgeons realize, and is accountable for many cases of obscure brachial neuritis.

8. **K. H. Aynesworth,** Waco, Tex., suggests the term cervicobrachial syndrome to replace scalenus anticus syndrome. He reported several cases which he considered illustrative of the traumatic origin of the syndrome, some of the neuritic and others of the vascular types. Resection of the rib following tenotomy of the scalenus anticus was necessary in several instances. Dr. Aynesworth presented a number of possible mechanisms for the development of the syndrome.

In discussing the latter two papers, **Mims Gage,** of New Orleans, La., referred to conditions which might be responsible for the scalenus anticus syndrome, including a low origin of the cervical plexus, failure of descent of the shoulder girdle, and spasm of the scalenus anticus muscle. He emphasized the importance of novocain injection of the anterior scalene muscle as a diagnostic measure in the diagnosis of the condition. In many cases, the brachial plexus and subclavian artery pass through the muscle. Dr. Gage drew attention to both the scalenus anticus major and minor muscles; the latter has been demonstrated in 60 per cent of special dissections. He suggested that an effort be made to locate the scalenus minimus muscle behind the plexus. Most cases of scalenus anticus syndrome occur in women. **Lucian Landry,** New Orleans, La., reported four cases of displaced subclavian artery which had been misdiagnosed as aneurysms. They were all cases with a cervical rib. **Alton Ochsner,** New Orleans, La., presented a simple diagnostic test; i.e., putting the scalenus anticus muscle under tension, by having the patient turn his head to the same side, will induce the symptoms. Oscillometric tracings may also be of diagnostic value. Because recurrences sometimes occur after simple division, excision of a segment of the hypertrophied muscle should

be done. The majority of his cases were on the right side, although most of Dr. Donald's were on the left. The syndrome is particularly likely to be induced or aggravated while the patient is sweeping with a house broom.

Dr. Donald, in closing, reported only one case in his series which was definitely associated with trauma. Two cases of scalenus anticus syndrome followed anesthesia; one was an obstetrical patient, who was given rectal anesthesia; and one was a patient who had been operated upon under spinal anesthesia for appendicitis. Eighteen cases had more severe pain at night. Pain is relieved by throwing the shoulders back. Sleeping reverses this and causes pain. In conclusion, Dr. Aynesworth states that in the instance of tractor drivers suffering with the syndrome, he was able to afford relief by means of a figure-of-8 bandage or brace for the shoulders.

9. **Mims Gage,** New Orleans, La., discussed the method of developing the collateral circulation of arterial aneurysms of the peripheral arteries. Collaterals usually developed spontaneously. Sympathetic nerve irritation is likely to occur, and tends to cause spasm of the artery and the collaterals distal to the aneurysm with resultant diminished blood volume flow and nutritional deficiencies. The treatment of choice for arterial aneurysm is the obliteration of the vessel. The methods for testing the circulation are: (1) Matas compressor, (2) oscillometer, (3) plethysmograph, (4) Moszkowicz method, and (5) thermocouple. Arteriograms have shown that there is a deficiency of collateral circulation in the region of the knee and, in some instances, in the region of the elbow. Ischemic gangrene developing after the ligation of large arteries, as reported by Dr. Matas, occurs in 5.2 per cent of cases, and, according to Tuffier, in 40 per cent of cases. Dr. Gage cited a mortality incidence in ligation of the common carotid artery reported by DeFourmestraux as follows: for hemorrhage, 54 per cent; for tumors, 46 per cent; for aneurysms, 13.5 per cent; and for pulsating exophthalmus, 7 per cent. The various methods for developing collateral circulation include the Matas compressor, alternating positive and negative environmental pressure, and intermittent venous occlusion. The rationale of sympathetic nerve section is to overcome vasospasm, produce vasodilatation, increase blood volume flow, increase arterial blood volume flow distal to ligation, increase the size of the vasa vasorum, and prevent ischemic gangrene. The types of sympathetic nerve section are classified as: chemical, including novocain and alcohol; and mechanical, including surgical. The aneurysmal sac becomes smaller and the associated arterial spasm is relieved. A series of cases was reported in which the results had been most gratifying.

10. **W. D. Gatch,** Indianapolis, Ind., reported a case of large false aneurysm of the right subclavian artery caused by a gunshot wound. A pulsating mass developed and the axillary artery was ligated. Years later, after coughing, the mass in the supraclavicular region suddenly increased to the size of a grapefruit. Preliminary ligation of the innominate gave incomplete hemostasis. An endaneurysmorrhaphy was done with preparations made for a possible massive hemorrhage. Part of the manubrium and right clavicle were resected. The sac was opened and the opening communicating the aneurysmal sac and the artery was instantly occluded by means of a finger. The opening could not be sutured nor could the artery be ligated through the sac, so the opening was plugged with a flap of the sac wall. Eight months postoperatively, examination revealed an excellent result, there being no pulsation or mass. Dr. Gatch suggested that a free graft of sac wall might be used instead of a flap, and he added that this should not be done before the false sac has developed; i.e., after three or more months.

11. **Rudolph Matas,** New Orleans, La., gave a synopsis of a case of cavernous hemangioma which was evident at birth in 1904. The lesion gradually progressed

from the finger to the shoulder, which latter region did not become involved until the patient was 21 years old. The arm was amputated and ten years passed before two new angiomatous formations occurred, one in the axilla and another in the right sixth intercostal space. Because of thinning skin and threatening rupture, excision of the axillary mass became mandatory. The hemostatic problem here was most serious. Dr. Matas used turpentine as a hemostatic agent for the bleeding granulation tissue which followed operation. The mass was, in effect, a tremendous sieve of arteriovenous aneurysms. Subsequently, a mass developed, apparently involving the subclavian artery. Compression of the mass raised the blood pressure and resulted in slower pulse, and fluoroscopic examination showed diminution of the size of the heart. The subclavian artery was ligated following temporary arrest of the innominate artery, and subsequently amputation was done. A recent report from the patient indicates that he is well and active, has married, and has a child 4 years old who has no angiomas. Dr. Matas is of the opinion that anlage embryonic cell nests remaining dormant for years account for the lesion. Although at first the tumor was thought to be clinically malignant, although histologically benign, the survival of the patient proved the case to be clinically benign as well. The area on the chest was treated with x-rays and the lesion disappeared.

Barney Brooks, Nashville, Tenn., commented on the courage of Dr. Gatch in attacking the large aneurysm. In discussing Dr. Matas' paper, Dr. Brooks spoke of the danger of air embolism occurring during operations on angiomas. **Arthur W. Allen,** Boston, Mass., stated that there are not many cases of syphilitic aneurysms in New England, nor are many cases of arteriovenous aneurysms encountered in that territory. However, many cases of aneurysms due to arteriosclerosis are observed. This latter type of aneurysm frequently occurs in the popliteal region and leads to thrombosis. In one such case, injection of the lumbar sympathetic ganglia, first with novocain and subsequently with alcohol, resulted in the disappearance of the pulsating mass and, he believes, prevented the development of gangrene. **James M. Mason,** Birmingham, Ala., demonstrated a method which he has developed for the control of main arterial supply in dealing with aneurysms at the base of the neck. An incision is made parallel to the sternomastoid, then parallel to the clavicle, and finally out to the anterior axillary fold. Flaps are made and the clavicle is divided distal to the attachment of the sternocleidomastoid muscle. By retracting the divided clavicle, all important structures are exposed. **Joseph A. Danna,** New Orleans, La., discussed the inadvertent entry into an aneurysm and said that hemorrhage may be controlled by occlusion of the opening into the artery by means of a finger through the sac. He also drew attention to the importance of looking for a second or third opening. **J. L. Campbell,** Atlanta, Ga., discussed the difficulties and dangers associated with opening of the sac before placing controlling catheters or ligatures proximal to and distal to the aneurysm. He recommended the resection of part of the clavicle rather than simple division of that bone.

In closing, Dr. Gage reiterated that sudden ligation of major arterial trunks is extremely dangerous. He did not offer the method of developing collateral circulation which he described as a cure, but rather as an adjunct in the treatment of aneurysms involving the peripheral arteries.

12. **Frederic W. Bancroft,** New York, N. Y., advocated a modified Kondoleon operation for sclerosed leg with ulceration. The operation is intended for cases with varicose veins associated with so much fibrosis that injection, ligation, or both of these procedures, cannot be expected to afford, or have proved incapable of affording, relief. The performance of the modified Kondoleon operation increases the success of skin grafts applied after excision of varicose ulcers. Fol-

lowing the operation, induration and coldness of the leg disappeared and the calf of the leg became soft. Dr. Bancroft advises performance of the operation only in severe cases, and referred to Dr. Hugh Trout's report on the same procedure in 1929. Dr. Bancroft believes that the encircling scar tissue is the most important factor, a concept different from that of Dr. Trout. It was recommended that the placing of grafts be done seven to ten days following Kondoleon operation, as immediate grafting was not successful. Compression or support by a Unna paste boot should be continued for some time following the operation. The average duration of ulcers was fourteen years. Of 20 cases reported, 12 have remained healed, 2 had fair results, and 2 were failures. Too great a delay in skin grafting will result in failure of the entire procedure. The incision must be made long enough and must be continued until soft tissue is encountered, at both ends of the incision.

13. **Carrington Williams,** Richmond, Va., in reporting cases of hysterical edema of the hand and forearm, cited various hysterical conditions which produce lesions appearing to be surgical. Edema may be caused by venous congestion with resulting increased tissue pressure, and the size of the leg is increased following prolonged standing. Dr. Williams reported three cases in which hysteria was a cause of edema. The first case was that of a girl, 14 years of age, who complained of painless pitting edema of the left hand and forearm. The arm was red and hot and its appearance suggested the existence of inflammation. Twelve hours of recumbency in bed resulted in relief. This case was considered to be one of major hysteria caused by unhappiness of the child. The second case, under the care of Dr. William F. Rienhoff, Jr., was that of a man, 40 years of age, who complained of red, tender swelling of the arm and forearm. He had been treated by a Hopi Indian medicine man. The arm and forearm were elevated in a plaster of Paris cast with resulting great improvement, except that the mobility of the fingers was not restored. The third case was that of an elderly Chinese beggar who had areas of ulceration of the hand. The results were not so good in this case. Dr. Williams called attention to the fact that the left hand was involved in all three cases. He proved experimentally that maintenance of a normal upper extremity in the dependent position for four and one-half hours will cause an increase in the volume of the part.

In discussing this paper, **Addison G. Brenizer,** Charlotte, N. C., stated that he believes that the edema associated with varicose veins is due to a lymphangitis and not to a phlebitis. In discussing Dr. Bancroft's paper, **Hugh H. Trout,** Roanoake, Va., said that, no matter how extensive the Kondoleon operation, there will be recurrences. **Margaret Stanley-Brown,** New York, N. Y., in discussing Dr. Bancroft's paper, stated that, if the Kondoleon operation is to be successful, the patient should remain under observation for six weeks. Dr. Stanley-Brown presented some of the pitfalls in the performance of the Kondoleon operation and advocated avoidance of operation in the presence of infection, preoperative elevation of foot with bed rest, and postoperative application of a Unna paste boot. A single incision was said to result in sufficient gaping; 1:5,000 acriflavine dressings are used in preparation for grafting. Hospitalization for two weeks before and for four to six weeks following the operation is usually required. **Howard Mahorner,** New Orleans, La., discussed Dr. Bancroft's paper and called attention to the fact that back pressure, infection, and scarring are factors responsible for persistence of varicose ulcers. He mentioned the importance of low ligation or the excision of segments of veins where leaks occur. He also discussed the comparative tourniquet test. **Robert L. Rhodes,** Augusta, Ga., spoke of the importance of removing foci of infection in order to avert recurrence following the Kondoleon operation.

14. **Addison G. Brenizer,** Charlotte, N. C., in a presentation concerning hemolytic jaundice, stated that hemolysins created in the spleen were responsible for the destruction of the red blood cells and that blood given by transfusion is also hemolyzed in the same way.

15. **Charles Gordon Heyd,** New York, N. Y., considered the factors of mortality in operations on the external biliary system and a collective series of 3,986 operations performed on the biliary tract over a period of seventeen and one-half years, with a 7 per cent mortality. The operations for chronic cholecystitis were performed by 53 surgeons; whereas, 31 surgeons performed the operations upon the acute cases. One-fifth of the cases were Dr. Heyd's personal ones. Malignancy, embolism, coronary thrombosis, inadequacy of preoperative treatment, and lack of judgment in selecting the proper operations, as well as delay on the part of the patient, were presented as factors which maintain the high mortality rate in operations on the biliary tract. The preparation of patients with cholecystitis for from six to twenty-four hours before operation has been statistically shown to halve the mortality associated with immediate operation. Longer periods of preparation, however, are associated with a rising mortality. Previous attacks of acute cholecystitis double the mortality.

16. **W. H. Parsons,** Vicksburg, Miss., reviewed statistics on the immediate and end results of cholecystectomy in American and foreign clinics. The mortality in previously reported series varied from 1 to 12 per cent. The mortality in Parsons' 100 personal cases of gall-bladder and bile duct operations was 6 per cent. Better late results were obtained in those cases in which stones were present. Dr. Parsons felt that allergic patients should be cautiously subjected to operation.

17. **Arthur W. Allen,** Boston, Mass., reported on follow-up observations after operations for stone in the common bile duct, with special reference to graded dilatation of the sphincter of Oddi. He referred to a report presented before this society five years ago regarding the passage of bougies in operations involving the bile ducts, and stated that the common bile duct should not be opened and then closed without leaving a T-tube in place, especially if the papilla has been instrumented. He believes that retrograde dilatation of the sphincter of Oddi is inferior to dilatation beginning within the duct. He uses Bakes' graduated dilators or sounds, and emphasized that the dilators are not "common duct" dilators. The smallest dilator is 3 mm. and the largest one is 14 mm. in diameter, and it is rarely necessary to use a dilator larger than the 10 mm. size. The larger ones may be used to advantage in cutting down on the sphincter of Oddi. The average dilatation has been 7 mm., which corresponds to that effected by the No. 20 French catheter, devised by Cheever for the same purpose. The mortality was less in the common duct cases in which dilatation was done; i.e., 3.9 per cent in the dilated cases than in the nondilated cases (5.1 per cent). However, the mortality in the dilated cases was higher than that in the entire group of biliary tract operations. In secondary operations when dilatation was done, there was a 1.42 per cent mortality; whereas, when dilatation was not done, there was a 5.14 per cent mortality. Fatal bile peritonitis and pulmonary complications were greater in the dilated cases, but, by correcting the condition responsible for bile peritonitis, the increased mortality due to this complication can be prevented. The patient must be taken back to the operating room and exploration done if no bile is draining from the tube in the common bile duct or if bile is seen on the dressings, although not coming through the tube.

In discussing the last three papers, **Frank H. Lahey,** Boston, Mass., observed that mortality and morbidity in cases with stone in the common bile duct are

related to the time factor. Since the infection factor is so important and prolongation of the disease means prolongation of the infection, the relation of infection to common duct stone should be appreciated by the medical men. Dr. Lahey advocates more frequent common duct exploration because stones are often present in the ducts and not in the gall-bladder. Dr. Lahey stressed the importance of an adequate incision in the abdominal wall, but said that elevation of the back of the patient is of no value. The surgeon should pack off the stomach, intestines, and omentum to the left until the foramen of Winslow and the vena cava can be seen. Then the foramen of Winslow should be blocked off to prevent spillage into the lesser peritoneal sac. Dr. Lahey believes that exploration of the duct is especially important in operations for acute cholecystitis. If the bile is anything but normal in color, the duct should be drained. **W. D. Gatch,** Indianapolis, Ind., advocated the use of a silk urethral bougie instead of the metal dilators. He believes that cholecystitis is primarily chemical and that infection is secondary. In discussing Dr. Heyd's paper, **W. A. Bryan,** Nashville, Tenn., spoke about the harm of long delay in instituting operative treatment and advised against performing other operations at the time of operations on the biliary tract. **Harold L. Foss,** Danville, Pa., reported eight cases of gallstone ileus, including a fatal case in which there were two stones, the second one having been overlooked. A search should be made for multiple stones in cases of gallstone ileus. **Henry Cave,** New York, N. Y., classified the terms commonly used in reference to operations for acute cholecystitis, as follows: immediate or emergency, within three hours; early, twelve to seventy-two hours; delayed, three days or longer. He advocated a period for the study and preparation of the patient before performing any operation for acute cholecystitis. Dilatation of the papilla results in a shorter period of bile drainage following operations on the common duct. **Waltman Walters,** Rochester, Minn., advocated being content with operations on the gall bladder or the bile ducts, deprecating even the simultaneous performance of an appendectomy or pyloroplasty. He commended dilatation of the sphincter of Oddi in selected cases; i.e., those in which the common bile duct is enlarged. He said that there are still indications for the performance of cholecystostomy and recommended this operation for poor risk cases, and in diseases of the head of the pancreas. **R. L. Sanders,** Memphis, Tenn., cited two periods in his experience in the surgical treatment of biliary tract diseases. He has improved his results by better preoperative preparation of his patients. He described a method of conserving bile by elevating the tube extending to the common duct above the level of the bed. **Hubert A. Royster,** Raleigh, N. C., expressed the feeling that a new chapter is about to be written in the history of biliary surgery. In earlier periods, only the gall-bladder stones were removed; then the stones and the gall bladder were removed. The final satisfactory solution of the problem will come when it is possible to control the primary cause of biliary tract diseases, which is a disease or abnormal function of the liver.

18. **John J. Morton,** Rochester, N. Y., reviewed the diagnosis and treatment of acute pancreatitis and stated that the diagnosis of this condition is very unsatisfactory. At least three types of inflammation should be considered: edematous, hemorrhagic, and suppurative. Sudden and severe pain is evidenced in all cases. Although vomiting is present in 75 per cent of the cases, it is not a reliable factor. Jaundice is present in only 33⅓ per cent and shock is present in some cases. There is a relative increase in pulse as compared to temperature. Tenderness is usually present in the left costovertebral area. Spasm and distention are sometimes present. The white blood cell count averages 17,000 cells per cubic millimeter. There is sometimes an accompanying glycosuria. Most of the patients are obese. Correct diagnosis is made in only 17 per cent of the

cases on the above basis; therefore, he decided to employ a test which would be more dependable in the diagnosis of acute pancreatitis. He selected Somogi's starch test for amylase. The mean level of amylase in this method lies between 70 and 200. Some of his cases had readings as high as 1,600, and in one case a reading of 3,600 was obtained. Acute pancreatic abscesses should be drained, but at present not many surgeons operate for the acute fulminating hemorrhagic type. These cases often require exploration for other possible lesions, such as ruptured peptic ulcers, acute cholecystitis, etc. Splitting the capsule of the pancreas is not effective and should not be done. Drainage should be established in order to allow the sequestration of necrotic masses of pancreatic tissue. The characteristic opalescent material may be obtained by diagnostic aspiration of the peritoneal cavity. The average mortality when early operation is done is 49 per cent; whereas, delayed operation performed in 161 foreign cases was associated with a mortality of only 18 per cent in all varieties of the disease. The amylase test is of practical value in the edematous type, which, incidentally, tends to subside. Acute pancreatitis and acute parotitis are analogous in that in both of the conditions the blood amylase is elevated. Because of the favorable results obtained in the treatment of parotitis by x-radiation, Dr. Morton has employed x-ray therapy in cases of acute pancreatitis. Through two portals, 250 to 450 r. units were administered with encouraging results.

In discussing this paper, **Roy D. McClure,** Detroit, Mich., discussed the Turner and Cullen signs. By means of a colored lantern slide, he demonstrated the discoloration in the flanks, more marked on the left side, which was observed in one of his cases of acute pancreatitis. **Irvin Abell,** Louisville, Ky., questioned the occurrence of pancreatic edema as a distinct and final entity. The various degrees of pancreatitis are merely different stages in the same process. The less done to the pancreas, the better, and drainage of the gall bladder is a helpful procedure in some cases. **George G. Finney,** Baltimore, Md., reported on 21 cases of acute pancreatitis admitted to the Union Memorial Hospital. In only a few instances was the accurate diagnosis made. Immediate operation was performed in all cases, and in some cases the gall bladder was drained. The region of the pancreas was drained, but the pancreas was not incised.

19. **William E. Lower,** Cleveland, Ohio, showed two motion pictures, one showing the Coffey method of ureteral transplantation, and the other one illustrating the technique of cystectomy.

In discussing these pictures, **Addison G. Brenizer,** Charlotte, N. C., described the operation of bilateral ureteral transplantation which he has previously presented. **Henry L. Douglass,** Nashville, Tenn., stated that he had tried Brenizer's operation, with resulting stenosis of the ureter. In using the operation demonstrated by Lower, he warned against taking deep bites into the ureter along the portion buried in the gut wall. In experiments on dogs he found that poor healing often led to the ureter entering directly into the bowel. To avert this undesirable occurrence, he advocates placing a drain along the bed in which the ureter is buried. **W. Lowndes Peple,** Richmond, Va., reported three cases of ureteral transplantation. **Francis Randall Hagner,** Washington, D. C., believes that in transplanting dilated ureters it is better to introduce a catheter through the ureter.

20. **Ambrose H. Storck,** New Orleans, La., presented a series of 46 penetrating wounds of the abdomen, 35 of which were gunshot wounds and 11 of which were stab wounds. The cases were statistically summarized and analyzed in relation to the recent advances in surgical practice which are applicable in the treatment of these injuries. The importance of hemorrhage in relation to the management and prognosis, the preoperative preparation, the criteria for the selection of cases

for operation, the methods for determining the optimal time for operation, and the postoperative care of patients with penetrating wounds of the abdomen were considered.

In discussing this paper, **Rudolph Matas,** New Orleans, La., said that Charity Hospital in New Orleans has had more material available for studies on this subject than any other hospital in the world. Memphis, Tenn., Atlanta, Ga., Louisville, Ky., and Birmingham, Ala., share New Orleans' unenviable position in respect to the high incidence of gunshot and stab wounds. It is important to study the wounds in detail, and important statistical compilations are being made from the recent Spanish Civil War experiences. Dr. Matas expects that China and Japan will furnish much important data on the subject of penetrating wounds of the abdomen. **Rettig A. Griswold,** Louisville, Ky., expressed the opinion that in icepick wounds laparotomy is not necessary, since such small perforations as might occur will spontaneously become effectively sealed off. The peritoneoscope has been used for the detection of blood, intestinal contents, or perforations, thus avoiding about 10 per cent of the unnecessary operations.

21. **Roger Doughty,** Columbia, S. C., in a report on chronic obstruction of the first portion of the duodenum by congenital bands, described observations which he and **George H. Bunch,** Columbia, S. C., have made. He discussed the symptoms which simulate those produced by pyloric stenosis. The operative procedure employed in their cases, i.e., cutting along the outer right avascular peritoneum, was illustrated. The bands do not seem to reform and recurrence of symptoms does not occur. The belief was expressed that the condition has frequently been overlooked and thereby many lives have been lost.

In discussing this paper, **Lon W. Grove,** Atlanta, Ga., reported two cases of congenital intestinal abnormalities. One was a case of malrotation and the other a case of duodenal obstruction. **Kenneth Aynesworth,** Waco, Tex., discussed the anthropologic aspects of malrotations of the intestinal tract.

22. **Roy D. McClure,** Detroit, Mich., in a consideration of operative technique in partial gastrectomy, emphasized that the ease with which this operation can be done is related to the condition of the patient. He stated that he leaves an indwelling gastric catheter in place for five days. Under spinal anesthesia, an incision is made along the midline, with the removal of the umbilicus in many cases. He places a specially designed clamp around the pylorus after its mobilization, and he uses a modified Furniss clamp across the duodenum. Two hundred cubic centimeters of an antiseptic, developed by Hartmann, is placed in the stomach two hours preceding operation. In order to avoid slippage of the stomach through the Payr clamps, which he applies to the stomach, Dr. McClure uses Payr clamps to the tips of which clamps are attached. He performs the Hofmeister-Finsterer type of anastamosis.

In discussing the paper, **Samuel Marshall,** Boston, Mass., said that he operated on only 8.2 per cent of duodenal ulcers, but on about 33 per cent of gastric ulcers. He stated that surgeons at the Lahey Clinic now do seven resections to three of the more conservative operations. He reported only 1 death in the last 88 resections, this fatality being due to pulmonary embolism. He said that Dr. McClure has had 1 death in 53 resections. He depends upon the high gastric acidity or the preoperative administration of hydrochloric acid for sterilization of the stomach. It is his practice to do an antecolic anastomosis, because an anterior anastomosis is easier to perform and, furthermore, it is easier to take down such an anastomosis should a marginal ulcer develop. An enteroenterostomy is not done because of the undesirable deprivation of the anastomosis site of the alkaline secretions which follows this procedure.

23. **Edwin P. Lehman,** Charlottesville, Va., presented a preliminary report on the experimental control of intra-abdominal adhesions. Heparin was tested for its effect in preventing the deposition of fibrin following the division of peritoneal adhesions. Both dogs and rabbits were used in the experiments. Peritonitis was produced by perforating the appendix. Three thousand units of heparin were introduced into the peritoneal cavity at the time of operation and repeated on the first and second postoperative days. Control observations were made using (1) saline solution, (2) amniotic fluid, and (3) nothing. The group of animals to which heparin was not administered developed 150 per cent as many adhesions following the division of previously existing adhesions; whereas, there was only a 26 per cent recurrence of adhesions in the instance of the animals who received heparin. Although already formed thrombi are not affected by heparin, the possible danger of hemorrhage following the use of heparin has so far made Dr. Lehman hesitant to recommend the method for clinical use. **R. L. Sanders,** of Memphis, Tenn., said that he has used amniotic fluid in about 300 cases during the past ten years, with gratifying results. **Mims Gage,** New Orleans, La., spoke of the use of papain solution for the prevention of the recurrence of peritoneal adhesions. **Thomas C. Davison,** Atlanta, Ga., reported follow-up observations on cases in which mineral oil was introduced into the peritoneal cavity for the intended purpose of preventing adhesions. He reoperated on some of the cases and found oleomas, which were at first diagnosed as sarcomas, both clinically and by pathologists. He now uses amniotic fluid. **Joseph E. J. King,** New York, N. Y., said that he has used papain solution in 30 cases with peritoneal adhesions, and he added that he plans to use it for the prevention of meningeal adhesions.

25. **H. A. Gamble,** Greenville, Miss., discussed anchorage of the mobile cecum, and based his conclusions concerning this procedure on 310 cases, most of whom were females. The normal fixation of the cecum is related to normal function of the entire gastrointestinal tract. He cited four grades of abnormal mobility of the cecum and reviewed the theories which have been offered to explain the development of mobile cecum. On the basis of the clinical manifestations produced, he classified the types into the gastric, biliary, renal, duodenal, and right iliac fossa types, and added that sometimes the symptoms are systemic as a result of abnormal intestinal absorption due to intestinal stasis. Simply removing the appendix does not afford relief to patients with a mobile cecum. Fixation of the cecum on the psoas shelf has been suggested, but Dr. Gamble recommends forming a new bed for the cecum and the ascending colon along the right peritoneal gutter. From 210 replies to questionnaires, he found that 75 per cent were cured, 15 per cent were improved, and 10 per cent were unimproved. There were no mortalities.

In discussing this paper, **Charles Rosser,** of Dallas, Texas, said that he believed that the after care which the patients received must have contributed to Dr. Gamble's good results. Dr. Rosser does not believe that the operative procedure is necessary, and he has abandoned it.

26. **M. J. Henry,** Louisville, Ky., in a presentation devoted to acute intestinal obstruction, outlined the differences between obstruction due to neoplasia and ileus due to other causes. He reviewed 182 cases of nonmalignant obstruction, 70 per cent of which were operated upon by **Irvin Abell,** Louisville, Ky., and 30 per cent of which were operated upon by himself. Pain and vomiting were present in 95 per cent of the cases. Distention was the next most frequent sign. Dr. Henry reported 20 deaths in the group of cases in which obstruction was due to adhesions. In 9 of these cases, intestinal resection had been performed. The mortality was higher when the patients had not had a previous operation, because of the delay in diagnosis in such cases. He reported a 19 per cent mortality in

53 cases of external hernia and a 50 per cent mortality in 10 cases of volvulus. In 6 operative cases of gallstone ileus, there was a 50 per cent mortality. Of 12 cases of intussusception, 11 were operated upon, with a 36 per cent mortality. One of the fatal cases had a mesenteric thrombosis. The single patient in this series in whom intestinal obstruction was due to imperforated anus lived. The total mortalities, according to some of the surgical procedures employed, were as follows: enterostomy, 100 per cent; freeing adhesions and enterostomy, 39 per cent; freeing adhesions alone, 17 per cent. In the future, operative procedures will have much less place in the therapy of intestinal obstruction, because of the development of apparatus and criteria for the nonoperative management of ileus.

In discussing this paper, **Elmer H. Adkins,** Miami, Fla., reiterated the importance of early diagnosis in intestinal obstruction. **James D. Rives,** New Orleans, La., discussed the pros and cons of treatment of obstruction with the Miller-Abbott tube and warned against the improper use of this method. He reported 17 cases of ileus in which the Miller-Abbott tube was used at Touro Infirmary. In 14 instances the tip of the tube passed through the pylorus. Two of the failures occurred in children. Dr. Rives reported 4 deaths in the series, none of which were attributable to the use of the tube. In one case death caused by pneumonia averted death due to intestinal necrosis, which autopsy revealed was impending as a result of overinflation of the balloon. He said that now he never introduces more than 40 c.c. of air into the balloon. Subsequent operation was necessary in one of the cases. If free bowel movement (diarrhea) does not occur within twelve hours, the tube treatment should be considered unsuccessful. **Edward Vernon Mastin,** St. Louis, Mo., reported the case of a child 5 years of age who within a period of 14 months had three ileocolic intussusceptions, for which the following operations were performed: (1) reduction of the intussusception, appendectomy, and suture of the ileum to the cecum; (2) simple reduction of the intussusception; and (3) fixation of the cecum.

27. **Charles H. Watt,** Thomasville, Ga., in presenting a modified spur-crushing clamp, spoke about exteriorization operations employed in the treatment of lesions of the left colon. The clamp which he has devised eliminates long convalescence, undesirable persistence of the colostomy, and the necessity of repeated applications of a spur-crushing clamp. He discussed the difficulty of closing the colostomy in some cases and said that he believes that failure of the colostomy to remain closed is most often due to the insufficient crushing of the spur effected by other types of clamps. Dr. Watt's modification of the usual spur-crushing clamp consists essentially of the addition of a thin central blade which can be sutured to the adjacent loops of sigmoid at the time of operation, and which subsequently serves as a guide when the crushing element of the clamp is applied.

28. **Foy Roberson,** Durham, N. C., reported two cases of solitary cyst of the spleen. A personal case was of the true serous or lymphatic type. The other case, a hemorrhagic cyst, was under someone else's care. He classified cysts of the spleen into three types: hydatid, hemorrhagic, and lymphatic. In 646 splenectomies performed at the Mayo Clinic between 1900 and 1934, only 2 cases of cyst of the spleen were observed. Trauma, degenerative changes, or neoplasia may cause solitary cysts of the spleen. There is no constant dependable sign or symptom, but in the instance of large cysts a mass may be detected. X-ray examination revealed a large spleen in Dr. Roberson's case, and the radiologist suggested the diagnosis of cyst of the spleen. Many cysts of the spleen will be found to be amenable to nonsurgical treatment.

In discussing Roberson's paper, **Charles Gordon Heyd,** New York, N. Y., said that solitary cysts are not rare. He drew attention to the fact that normal

life is possible after removal of the spleen. **John deJ. Pemberton,** Rochester, Minn., cited that since 1904 in 800 cases of splenectomy at the Mayo Clinic there have been only 4 cases of solitary cyst, so he agrees with Dr. Roberson that they are rare. Three of these cases were females. There was no history of trauma in any of the cases treated at the Mayo Clinic.

29. **Warfield M. Firor,** Baltimore, Md., in discussing the treatment of Addison's disease by the implantation of synthetic hormone, stated that destruction of the adrenal cortex, as described by Addison, has been known for only eighty-five years to be the cause of morbidity and death. In 1930, Pfiffner and Swingle isolated a potent adrenal cortex extract. In 1933, Loeb, of Columbia University, drew attention to the value of administering large amounts of sodium chloride in the treatment of Addison's disease. Dr. Firor reiterated that potassium is also important. His report was concerned with observations made following the implantation under the skin of pellets of desoxycorticosterone acetate. One pellet of the substance, weighing 100 to 150 mg., must be implanted for each 0.5 mg. daily requirement of the hormone. Because patients with Addison's disease are such poor risks, the pellets are inserted in the operating room, in order to reduce to a minimum the possibility of infection at the sites of implantation. Sometimes as many as sixteen pellets may be introduced, thereby furnishing a supply of hormone sufficient for as long a period as nine months. Following this therapy, the plasma volume increases, the blood pressure is remarkably elevated, and there is an increase in body weight. Of the 17 patients treated with pellets, 15 have resumed their usual duties. Regeneration of cortical tissues, due to general improvement of the patient following desoxycorticosterone acetate, makes smaller subsequent doses of the hormone sufficient. It was anticipated that sufficient regeneration may eventually occur in some cases so that adequate normal function will continue without hormone therapy.

In discussing this paper, **Harvey B. Stone,** Baltimore, Md., said that Dr. Firor's work illustrated what might be accomplished by the cooperation of chemists, physiologists, and surgeons. Dr. Stone drew attention to his own work on the transplantation of tissues which secrete hormones. He transplanted adrenal cortex in three patients, all of whom were at least temporarily improved but all of whom are now dead. **George J. Heuer,** New York, N. Y., asked if there is any danger in the use of pellets.

Dr. Firor, in conclusion, stated that pellets should be hard in consistency in order to avert undesirably rapid absorption of the hormone. He always keeps his patients under observation for several weeks in order to determine the rate of absorption.

30. **John deJ. Pemberton,** Rochester, Minn., in discussing thyroglossal duct fistula, referred to Sistrunk's advocation of the complete operation for this developmental anomaly. Others before him had described or advised complete operations, but Sistrunk developed a method which assures removal of the entire tract, even when it is impossible to trace the duct throughout its entire length. The embryologic factors leading to the formation of thyroglossal sinus or fistula were presented. Pemberton reported 293 cases, some of the patients being past 60 years of age. Of 261 cases followed successfully, there were 4 cases (1.5 per cent) of recurrence. Many operations had been done previously on these patients, as many as ten operations in one case. The complete operation should be postponed until acute infection has been controlled. Preliminary incision and drainage is sometimes necessary. A transverse incision is made at the level of the hyoid. Since the portion of the tract above the hyoid cannot be seen, that portion of the tract must be cored out. A finger placed in the mouth against the base of

the tongue may assist in the dissection. Extensive scarring and infection, related to previous operations, is an important factor in recurrence.

In discussing the paper, **Frank Lahey,** Boston, Mass, agreed that only radical operations give good results. He reported 200 cases with the same experiences as Dr. Pemberton. Dr. Lahey deprecated the making of a longitudinal incision in operations for thyroglossal fistula, because of the very undesirable check-rein scar which follows. He drew attention to the occasional development of squamous cell carcinoma in thyroglossal fistulas. Dr. Lahey then presented some of his observations in regard to lingual thyroids. He advocated removal of lingual thyroids by the oral route; advised the employment of intratracheal anesthesia; spoke about the importance of the proper placing of packs within the mouth; and recommended the introduction of traction sutures through the tongue. The possibility of myxedema occurring following the removal of lingual thyroids was mentioned. **Vilray P. Blair,** St. Louis, Mo., reported having removed part of a lingual thyroid.

31. **V. P. Blair,** St. Louis, Mo., reported the case of a child who had lost the tip of her middle finger. The distal phalanx and part of the middle phalanx of the second toe was grafted to the remaining portion of the finger with very good cosmetic effect and satisfactory functional results.

32. **H. L. Kirkham,** Houston, Tex., discussed the use of preserved cartilage in ear reconstruction. He emphasized the difficulty of patterning a rib cartilage graft that will be thin enough, and also referred to the difficulty of satisfactorily modeling the cartilage. He believes that transplanted cartilage remains permanently as cartilage. He considers a weak aqueous solution of merthiolate and saline solution to be the best preservative. The solution should be changed every week. By making several perforations through the cartilage, granulation tissue can extend through the perforations and thereby anchor the graft. Dr. Kirkham illustrated the operative procedure as follows: the cartilage is buried under a flap, the incision for which begins well up in the hair line above the ear and mastoid; the ear is raised and brought forward; a tube pedicle is made from the neck; the tragus is formed; the pedicle is transformed to form the helix. Following completion of the ear, the pedicle is returned.

In discussing this paper, **Vilray P. Blair,** St. Louis, Mo., commended Dr. Kirkham. He said that dead cartilage does not unite with tissue as does living cartilage. He thinks that ear repair for congenital deformities should be done by the time the child is 5 years old. **John S. Davis,** Baltimore, Md., is of the opinion that autocartilage is distinctly preferable, but that isocartilage may be used if necessary.

33. **Donald Guthrie,** Sayre, Pa., in reporting on the incidence and diagnosis of hiatal hernia, stated that at the Mayo Clinic, between 1932 and 1937, there were 267 such cases. He said that there is a general increase in the frequency with which the diagnosis is made. The important role played by the clinician in detecting symptoms and requesting x-ray examination in suspected cases was discussed. He outlined the various types of hiatal hernia: (1) the congenital short esophagus with partial or complete thoracic stomach, (2) the paraesophageal hernia, and (3) the sliding hernia with shortened esophagus. Hiatal hernia can usually be recognized with the patient in the recumbent position, but the hernia is not likely to be revealed if the patient is standing. An esophagoscope should be used in those cases in which hemorrhage has occurred, to determine whether the bleeding is the result of carcinoma, ulcer, or hiatal hernia. Not all cases require surgical treatment. When operative repair of the defect is not considered necessary, or safe, the patient should eat small meals and remain in the upright

position for some time after meals, and eating late at night should be avoided. Appropriate doses of antispasmodics should be administered. In the case of obese patients, loss of weight often affords considerable relief. Dr. Guthrie discussed the occurrence of complications, such as ulceration of the esophageal mucosa, obstruction, hemorrhage, and cardiac failure. He advocates operative treatment if the diameter of the hernia is 5 cm. or more.

34. **Howard Mahorner,** New Orleans, La., spoke on umbilical and midline ventral hernias. He stated that, except for the size of the hernias and the shape of the opening, these types of hernias are very much alike. The incidence of umbilical hernias is greater in the negro than in the white population. Postoperative wound infection occurs less frequently, he stated, when silk is used as the suture material. The factors responsible for recurrence are: obesity, closure under tension, imperfect approximation, the type of suture material used, the type of operation employed, and infection. For preoperative preparation, Dr. Mahorner advocates weight reduction, increasing abdominal pressure with binders, cardiac and urinary studies, and supportive therapy. He advised two-stage operations for the large irreducible hernias, and advocated the introduction of transverse fascia strips between the linea semilunares to relieve tension on the suture lines.

In discussing this paper, **Bradley Coley,** New York, N. Y., recommended a longer period of preoperative care and preparation, sometimes keeping the patient in the Trendelenburg position. He administers pitressin for seventy-two hours preoperatively to reduce distention. Dr. Coley also felt that the use of silk reduces the incidence of recurrence. **Isidore Cohn,** New Orleans, La., believes that epigastric hernias are more frequent than is indicated in most statistics. He has been using a rectus sheath overlap operation for the past seven years. **Charles R. Robins,** Richmond, Va., suggested the use of a sling to relieve tension at the time of operation.

Rudolph Matas, New Orleans, La., demonstrated the case of a 44-year-old man with a very extensive venous hemangioma with pachydermal skin on the right hand. The lesions involved practically the entire right arm, forearm, and hand, the right chest wall and, to a lesser extent, the lower part of the left arm and upper part of the left forearm.

36. **Bradley L. Coley,** New York, N. Y., reported two cases of caisson disease, with special reference to the bone and joint lesions. He said that Erdman and Phemister are about the only others who have reported such cases. This disease is one of the unusual nonmalignant diseases of the osseous system. He reviewed the ancient history of caisson disease, and traced the development of diving suits and helmets. He discussed the retardation of nitrogen elimination from the spinal cord and the bones, a phenomenon which makes these structures particularly susceptible to the increased nitrogen tension caused by increased atmospheric pressure. Long bones are more likely to be involved than are the flat ones. Massive necrosis of the femoral shaft due to caisson disease simulates pyogenic osteitis and may be associated with deforming arthritis. He discussed the differential diagnosis and considered the workmen's compensation aspects of these lesions. Dr. Coley then reported two cases of caisson disease which he had observed in men who had worked as sand hogs.

In discussing the paper, **Isidore Cohn,** New Orleans, La., said that the bone changes present in Garré's disease or sclerosing osteitis are similar to those which he observed in the x-rays demonstrated by Dr. Coley.

39. **Frank L. Barnes,** Houston, Tex., reported a case of granulosa cell tumor of the ovary. About 300 cases are now on record. The presence of these tumors can be recognized preoperatively by the manifestations of excessive estrin

secretion. In children, granulosa cell tumors cause the precocious development of secondary sex characteristics. In young adults, the diagnosis is most difficult and sometimes is evidenced only by an increased menstrual flow. The occurrence of these tumors after the menopause may cause a recurrence of menstruation. Periods of menorrhagia may be interspersed with periods of amenorrhea. In the case which Dr. Barnes illustrated, menses ceased at 40 years of age and reappeared when the patient was 54 years old. Granulosa cell tumors may be associated with other tumors of the ovary and may occupy either part or all of the ovary. A solid tumor of the ovary, removed by **Albert O. Singleton,** Galveston, Tex., was also reported by Dr. Barnes.

40. **Thomas D. Sparrow,** Charlotte, N. C., presented a paper on leucoplakic vulvitis. He reviewed the history of the description of this condition. There has been much confusion in respect to nomenclature, probably because of varying opinions concerning its cause and the various manifestations in its different forms. The theories of etiology were reviewed, but the inadequacy of those so far advanced was pointed out. The primary hypertrophic phases with acanthosis are often followed by an atrophic phase with associated collagenous changes. It is a disease of the menopause or postmenopause. The disease is important because it is a precancerous condition, and malignancy at the time of operation was observed in about 50 per cent of the cases. About 36 per cent of patients with carcinoma of the vulva give a history of preceding leucoplakia. Differential diagnosis must be made between leucoplakia, lichen planus, scleroderma, syphilis, fungus dermatitis, etc. Local applications as a form of therapy are worthless. The various combinations of treatment which have been employed include the administration of hydrochloric acid, vitamin A, sex hormones hypodermically in solution or in pellet form as well as by local application and in the form of vaginal suppositories, and x-radiation. Surgical extirpation is often necessary or advisable. He then reviewed the various methods of excision and plastic repair which have been devised. He has observed postoperative persistence of pruritus or skin changes in a number of cases.

In discussing Dr. Barnes' paper, **Samuel L. Ledbetter,** Birmingham, Ala., cited a case of arrhenoblastoma which he had observed and presented this case as a counterpart to the granulosa cell tumor. A tumor the size of a grapefruit in the right ovary was found at operation. A tumor of undetermined histology, attached to the left tube, was also removed at the same time. Menstruation was re-established, voice changes were relieved, and a general return to feminine from masculine characters occurred. **Albert O. Singleton,** Galveston, Texas., stated that his case of tumor, referred to by Dr. Barnes, was removed incidentally, in the course of an operation for rectal prolapse.

REPORT OF THE FORTY-NINTH ANNUAL MEETING OF THE WESTERN SURGICAL ASSOCIATION, LOS ANGELES, CALIF., DEC. 15 AND 16, 1939

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THE forty-ninth annual meeting of the Western Surgical Association was held in Los Angeles, Calif., Dec. 15 and 16, 1939. **Vernon David,** Chicago, Ill., President of the Association, acted as chairman of the meeting. **Alfred Brown,** Omaha, Neb., was elected president for 1940. The place selected for the next meeting was Topeka, Kan.

The local committee had arranged an interesting program of operative and non-operative clinics at the Los Angeles County General Hospital which were held the day prior to the formal opening of the meeting. The following brief abstracts are compiled from the notes taken by three of us, **C. B. Puestow,** of Chicago, Ill., **W. R. Lovelace, II,** of Rochester, Minn., and myself, at the time of presentation of the papers. For any inaccuracies in reporting, apologies are herewith made.

CLINICS AT THE LOS ANGELES COUNTY GENERAL HOSPITAL

H. E. Schiffbauer, Los Angeles, Calif.: **Diaphragmatic Hernia.**—Eleven cases (those of 9 men and 2 women) of traumatic diaphragmatic hernia were reported, all of which were the result of automobile accidents and in all the hernia was on the left side. The symptoms in these cases had been of a few weeks' to ten years' duration. Pain which extended to the shoulder was an important symptom; fractured ribs and injuries to the lower part of the thorax and upper part of the lumbar region should be looked for. The patient is not placed in shock position, even though he is in shock, but a semi-Fowler position is employed. A Levine tube with suction is used; oxygen is used whenever indicated. Operation is not undertaken when the condition is in the acute phase, except when necessary to stop hemorrhage or perforation. A transpleural approach is employed in the chronic case or in the chronic case which has become acute. Occasionally the phrenic nerve is crushed as it enters the diaphragm; it regenerates in only three to four months. Holes are punctured in the ends of the ribs in order to facilitate tying them back together.

C. J. Berne, Los Angeles, Calif.: **Arterial Embolectomy.**—At the Los Angeles County Hospital, the ratio of embolic to thrombotic obstructions is 5 or 6 to 2. In the typical case of thrombophlebitis, a white, cold, painful, and tender leg may result from arterial spasm. In the first one or two hours, tenseness caused by edema often may be detected on palpation of the calf of the leg. Unless there is a propagation thrombosis, there may be shunting of the blood below the embolic lesion. In these cases the cold level is lower than would be expected. The patient is placed in the dependent position. No heat is applied because it increases the oxygen consumption of the tissue, thus favoring gangrene. Heat is applied to other parts of the body. The pavex machine is not used in cases of femoral obstruction because it cuts off collateral circulation. Papaverine may be of help. Injection of the sympathetic nerves with procaine hydrochloride (novocain) has not been very successful. Ligation of the saphenous vein was

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advised in the late cases. Thirty-one cases were reported; 30 of the patients were seen less than twelve hours after onset of symptoms. Embolectomy from femoral, brachial, and axillary arteries had been performed.

L. T. Bullock, F. S. Dolley, and **J. C. Jones,** Los Angeles, Calif.: **Ligation of Patent Ductus Arteriosus.**—In a careful review of 80 cases, it was found that 85 per cent of the patients died as a result of cardiac lesions, endocarditis, cardiac failure, and so forth. The symptoms described were continuous murmur in the second or third interspace, increased pulmonic second sound present in 8 of the 11 patients who were presented, prominent conus arteriosus, increased pulse pressure, lowering of diastolic blood pressure with exercise, which will give signs of aortic insufficiency, femoral sound, absence of cyanosis, and absence of axis deviation of the heart. There was a thrill in 9 of the 11 cases, which extended into diastole. At operation the approach is made through the second interspace. Intratracheal anesthesia is used and the lung is inflated about every ten minutes in order to avoid atelectasis. Care is taken to avoid the recurrent laryngeal nerve at the junction of the duct with the arteries. Practically all the symptoms disappeared postoperatively, and at the time of this meeting the patients had made satisfactory progress.

P. M. Wood, New York, N. Y.: **Experimental Work With Trichlor-Ethanol Basal Anesthesia.**—This agent is liquid, slightly ethereal in odor; it is heavier than avertin and there are 1,555 mg. in 1 c.c. In a series of 700 cases, Dr. Wood found frequent extrasystoles and arrhythmias, especially during induction and awakening. The pulse rate did not rise as high as on the use of avertin. The respiratory rate and volume exchange were higher than those noted with the use of avertin and the central nervous system is more excited with its use than with the use of avertin. The patient's color may become oyster white.

In discussion, **C. D. Leake,** Professor of Pharmacology of the University of California, emphasized the need for careful study of anesthetic agents and for consultations between the pharmacologists and anesthetists.

W. Baker, New Orleans, La.: **Resuscitation (Acute Asphyxia).**—In this condition a vicious cycle soon is reached in which anoxia causes paralysis of the respiratory center. Dr. Baker sees no need for administration of carbon dioxide, because in most cases there is an excess of carbon dioxide in the circulating blood. In deep asphyxia, he stated, positive pressure usually is necessary because of the loss of muscle tone, and Schäffer's method and other methods of artificial respiration do not give the necessary exchange of air. He expressed the belief that only 150 c.c. of air is forced in and out in this way, and this quantity represents only the dead space air. Mouth-to-mouth insufflation, it is believed, is excellent. Pharyngeal obstruction can be overcome by positive pressure.

E. H. Warnock, Los Angeles, Calif.: **Oxygen Therapy.**—The need for early administration of oxygen before the patient is moribund was emphasized. Increased elevation of temperature increases the demand for oxygen. Oxygen is given to patients with cardiac lesions when an acute condition is superimposed on a chronic one. In three hospitals in which oxygen tents were used, the average concentrations of oxygen were found to be only 22 to 28 per cent, which would be of practically no value. In pneumonia there is an increase in lactic acid as the result of anoxemia. Dr. Warnock discussed the use of the Boothby-Lovelace-Bulbulian inhalation apparatus for the administration of either high or average concentrations of oxygen or mixtures of helium and oxygen.

V. P. Thompson, Los Angeles, Calif.: **Intracapsular Femoral Neck Fractures.**—The author discussed those cases in which open reduction was necessary and then

his method of using a Smith-Petersen nail. His technique was illustrated in a motion picture.

B. O. Raulston and **H. J. Magnuson**, Los Angeles, Calif.: **A Demonstration of the Use of the Spectograph in the Analysis of Biological Material.**—The apparatus described was made practical by the use of a photoelectric cell with a controlled current. The authors employed a grading spectograph with 20,000 lines to the inch. They can determine the amount of silver in the body in cases of argyrol poisoning, as well as the amount of lead and bismuth in poisoning caused by these metals. They plan to study the distribution of minerals in the body, as, for instance, in the treatment of syphilis.

George Thomason, Los Angeles, Calif.: **Massive Resection for Extensive Intestinal Adhesions: Four Cases.**—The case of a woman who had undergone fifteen previous laparotomies and who had obstruction of the proximal portion of the ileum was reported. Resection was made of 5 feet (152 cm.) of jejunum and an end-to-side jejunogastrostomy was performed. Another patient suffered from an inflammatory mass in the right lower quadrant of the abdomen. Resection was made of 4 feet (122 cm.) of the terminal part of the ileum and the right half of the colon. An ileocolostomy between the ileum and transverse colon was performed. The third case was described as similar to the previous one; the condition was believed to be the result of a previous appendectomy. The same procedure as that described in the preceding case was performed. The fourth case was that of a woman who gave a history of six previous laparotomies and now had high intestinal obstruction. At operation the duodenojejunal junction was found to be on the right side and surrounded by a mass of adhesions. The adhesions were freed and a side-to-side enteroenterostomy was performed.

H. K. Bonn, Los Angeles, Calif.: **Review of 1,000 Gall-Bladder Operations.**—Sixteen patients were operated upon within forty-eight hours of the onset of symptoms of acute cholecystitis, with a mortality of 19 per cent. Sixty-four patients were operated upon between forty-eight hours and seven days after the onset of symptoms with a mortality of 7.8 per cent. The mortality in 427 cases which came to operation more than six days after the onset of symptoms was 5.4 per cent. The ratio of acute disease was about the same in men as in women, but more women had subacute cholecystitis. Dr. Bonn discussed the series of Drs. Hevers, Judd, Phillips, and Pennoyer.

A. C. Pattison, Los Angeles, Calif.: **Injection Treatment for Acute Thrombophlebitis.**—Injection of the lumbar sympathetic nerves with procaine hydrochloride (novocain) stops arterial spasm, prevents propagation thrombosis, and the increased blood supply prevents lymphatic blockage. In 11 cases in which this treatment was used, excellent results were obtained in 5 with complete disappearance of edema. In 3 cases, pain and tenderness only were relieved, but the course was the same. In 3 cases the symptoms ceased and there was only slight edema when the patient was in an upright position. In the favorable cases, the swelling diminished in twenty-four hours and was gone in ten days. The skin temperature at the toe was increased 2 to 8° F. after injection. A trial injection of papaverine first in all cases was recommended.

REGULAR MEETING

Edmund Andrews, Bloomington, Ill.: **Blood Ether Levels in Surgical Anesthesia.**—The author described a new method by which the amount of ether in blood may be determined in about fifteen minutes with an accuracy of 2 per cent. An exceedingly wide range of levels of ether in the blood was noted among dif-

ferent patients which indicated individual susceptibility. Venous samples of blood were taken in the second stage of anesthesia, before the operation had been started. Essentially the same levels of ether were noted in the blood of patients who had not received morphine preoperatively and those who had received morphine preoperatively. Morphine does not appreciably reduce the time or increase the ease of induction and often obscures the signs of anesthesia.

In discussion, **W. D. Gatch,** Indianapolis, Ind., stated that, when an apparatus similar to a drunkometer was used, ether was found in blood for as long as twenty hours after narcosis.

J. D. Bisgard, Omaha, Neb.: **The Influence of Certain Commonly Employed Therapeutic Procedures Upon Gastric and Intestinal Tone and Motility.**—A Miller-Abbott tube, with a connection to a U-shaped manometer and kymograph, was passed after the patients tested had been fasting. A thirty-minute normal record was taken. When a cold pack is applied to the abdomen, secretion of hydrochloric acid increases. Application of a hot pack causes inhibition of peristalsis and lessening of tone. Oral administration of hot water causes vigorous peristalsis. No effect or inhibition was noted after the oral administration of ice water. Hot packs on the thighs had little effect, but cold packs increased the peristaltic activity of the stomach and also increased the quantity of hydrochloric acid in the stomach. Horton and Brown stated that cold applied to the body releases histamine. The motility was not measured and so it may be that cold packs producing only peristalsis may not always be indicated. It is believed that the application of heat to the abdomen and the ingestion of warm water is indicated in the treatment of inflammatory lesions and bleeding ulcers when a sedative effect is desirable, and that ice packs and the ingestion of cold water, rather than the use of heat, are indicated for the relief of distention or conditions in which a stimulating or motor effect is desirable.

In discussion, **A. J. Brown,** Omaha, Neb., brought out the point that these studies were made mostly on normal subjects and that in appendicitis, also, cold packs may increase peristalsis and keep up tone rather than keep the bowel at rest. **H. H. Davis,** Omaha, Neb., stated that in an old study he had found that spinal anesthesia slowed up the elimination of barium. **C. A. Roeder,** Omaha, Neb., said that the level of acid in his stomach was low when he was in a hot country.

C. A. Nafe, Indianapolis, Ind.: **Reversed Intestinal Rotation: Case Report.**—The patient, aged 8 years, had a history of vomiting, pain beneath the umbilicus, inability to take food for nine days, and obstipation of four days' duration. He had had similar attacks intermittently since he was nine days old. Exploratory operation revealed reversed rotation of the large bowel, the transverse colon passing posterior to the superior mesenteric vein and artery. However, the duodenum passed through the mesocolon, to the right of the midline, and was not anterior to the transverse colon, as is usually the case. The veins of the mesentery were considerably dilated and moderate mesenteric lymphadenitis was present. A case of hernia of the small intestine into a mesenteric sac also was reported. This patient died fifteen hours after operation.

In discussion, **C. J. Hunt,** Kansas City, Mo., stated that the anatomy of the peritoneum in the cat is the anatomy of the human embryo before rotation occurs.

G. C. Penberthy, Detroit, Mich.: **The Treatment of Adynamic Ileus in Children.**—Adynamic ileus in children apparently is neurogenic in origin and represents a condition and aggravation of physiologic paralysis of intestinal motility which follows opening of the peritoneum and results from several causes. Mortal-

ity is likely to be higher among children than among adults because the former cannot withstand distention, loss of fluids, and an abnormal chemical balance as well as can adults. Methods of treatment include (1) prophylaxis, (2) enemas and local applications, (3) drugs, and (4) enterostomy (seldom). The most logical treatment is removal of the distention and gas by means of intubation with a balloon type of tube and the administration of oxygen with the B.L.B. inhalation apparatus. Illustrative cases were presented.

In discussion, **C. F. Dixon,** Rochester, Minn., stated that he often clamps and unclamps the tube intermittently.

Lawrence Chaffin, Los Angeles, Calif.: **Surgical Emergencies During Childhood Caused by Meckel's Diverticulum.**—Analysis had been made of 18 cases of laparotomy on children occasioned by Meckel's diverticulum. The group of cases included 16 boys and 2 girls. The symptoms of Meckel's diverticulum are so similar to those of appendicitis that a preoperative diagnosis rarely is made. Secondary anemia is suggestive of the condition, but roentgenologic examination is not of much help. The duration of symptoms in this group varied from a few hours to one year. Periodic anemia and slight rise in temperature should be watched as indications of the presence of Meckel's diverticulum. One diverticulum was 38½ inches (96 cm.) long and was situated in the mesentery parallel with the ileum so that it was necessary to resect the terminal portion of the ileum. In one case the diverticulum extended out to and through the umbilicus and a fecal fistula was formed. In another case, the diverticulum projected out of the ileum and had an external opening at the umbilicus with atresia of the midportion of the diverticulum into a fibrous band. The portion of the diverticulum which opened into the umbilicus contained a small ulcer; the gastric mucosa formed the lining of the diverticulum. Dr. Chaffin stated that, in order to avoid future bleeding, all of the diverticulum must be excised. Complications associated with Meckel's diverticulum include perforation, intussusception, peritonitis, volvulus, and intestinal obstruction.

H. L. Kretschmer, Chicago, Ill.: **Diverticula of the Urinary Bladder.**—There were 229 men and 6 women in the group of cases discussed, most of the patients being between 40 and 80 years of age. Most of the men had, in addition to diverticulum of the bladder, benign hypertrophy of the prostate gland. Practically all the patients had some type of obstruction. Tumors, as well as stones, occasionally were found in the diverticula, so it is well to watch for shadows near the brim of the pelvis in roentgenograms. A diverticulum situated near a ureter may cause renal damage. Routine removal of the diverticula is no longer performed, inasmuch as complete relief of obstruction often results in decrease in the size of the diverticulum. Patients with this condition should be watched and checked over for infection.

Thomas Joyce, Portland, Ore. (Guest Speaker): **Periarteritis Nodosum.**—The ratio of males to females suffering from this condition is 4:1. Until 1938, 214 cases had been reported in the literature; the condition occurs chiefly in the third decade of life. It is found in muscular arteries and arterioles; renal, mesenteric, coronary, hepatic, visceral, and cranial arteries. Nodules and an occasional aneurysm appear along the artery. There is degeneration of muscular fibers of media with necrosis, causing aneurysm, thrombosis, and fibrosis. There are four stages: degeneration, inflammation, necrosis, and scarring. The symptoms include Meyer-Brinkman triad, fever, general weakness and loss of weight, albuminuria, polyneuritis, skin lesions, and cardiac signs. The course of the disease is from three to four months. Termination usually is due to cardiac failure, marasmus, or local vascular accidents.

Urban Maes, New Orleans, La.: **Diabetic Gangrene: Mortality Factors.**—(This paper was presented by **H. C. Ilgenfritz,** New Orleans, La., the co-author.) A review was made of all cases of diabetic gangrene in which treatment had been given in the past six years at the Charity Hospital of Louisiana at New Orleans. Use of insulin has increased the number of diabetic patients who are at the age to have vascular disease. From 1934 to 1939, inclusive, 126 patients were seen, 57 of whom died. Ninety-eight of the 126 were operated upon with 45 deaths. There were 31 men and 95 women; 54 were white patients and 72 were colored. Moist gangrene was the common form of the disease. The presence of cardiac reserve and renal efficiency of these patients must be determined and the internist and surgeon must work together. Cellulitis is better treated conservatively than with incision and drainage. Moist gangrene prohibits local operation. Amputation is better delayed only for stabilization of the diabetes. Extension of gangrene is the chief cause of death; cardiovascular disease and arteriosclerosis are the next chief causes of death. Of the patients who die, 7 per cent have diabetic coma. In the care of these patients, glucose and insulin are administered; a cradle is used without light or heat, and the affected part is not elevated. Spinal anesthesia is administered, but a tourniquet is not used. Circular amputation without any flap is best, with loose closure and no drainage.

In discussion, **C. L. Callander,** San Francisco, Calif., stated that in cases of gangrene which he had followed, whether the condition was due to diabetes, arteriosclerosis, or other causes, in an early series of 157 cases, amputations through the thigh were performed with a mortality of 57 per cent; in a recent series of 125 cases, a tendoplastic amputation at the knee was performed, the technique of which he described, with a mortality of 15 per cent.

Kellogg Speed, Chicago, Ill.: **Hip Arthroplasty: Use of Vitalium Cap.**—Two cases were reviewed. The author described the technique by which he loosely applied a vitalium cap over the head of the bony ankylosed femur, after it had been freed up. The vitalium cap is not affixed to the head of the femur and, so far, atrophy or absorption has not occurred. He has not found it necessary to remove the cap as yet. Roentgenologic findings before and after the operation were presented.

Fred Christopher, Winnetka, Ill.: **Ambulatory Treatment of Impacted Hip Fracture.**—Five cases were reported in which there were impacted fractures of the neck of the femur with union and complete recovery following treatment by a short abduction spica cast, a 2-inch lift (5 cm.) on the shoe for the foot on the well side, and walking with crutches in a few days. Casts were left on for thirty to forty-five days. All cases were followed up for one year.

In discussion, **E. L. Gilcreest,** San Francisco, Calif., stated that he believed pinning was better in the hands of the average surgeon. He pointed out that in the cases reported all the fractures were impacted and none was of the shearing type. **F. E. Clough,** San Bernardino, Calif., mentioned that he uses Anderson's method of well-leg traction splint and is not in favor of metal in all fractures of the neck of the femur. **J. A. Jackson,** Madison, Wis., stated that he favors internal fixation with a nail. Blind nailing of reduction can be made; otherwise, open.

Earl C. Padgett, Kansas City, Mo.: **Osteomyelitis of the Jaw.**—Fifty-nine cases were reviewed. Extraction of teeth and infected teeth were the chief causes of the condition; other causes are sinus infection, trauma, mercury poisoning, leucemia, corrosive fluid, and blood-borne infections. Streptococci are the usual organisms found. Teeth and tooth buds act as foreign bodies and so influence

infections. The mandible is more often affected than the maxilla. The clinical course of the disease is characterized by pain, swelling, and bulging. In the acute phase of the disease, treatment should be conservative, but, after sequestration has occurred, radical treatment, including removal of the sequestrum, is most effective.

In discussion, **E. L. Gilcreest,** San Francisco, Calif., stated that, when osteomyelitis accompanies fracture of the mandible, if the teeth are accurately wired whenever possible and the wound is kept clean with Dakin's solution, the gap often will fill and heal well. **E. D. Twyman,** Kansas City, Mo., spoke of a group of cases in which osteomyelitis follows radical operation carried out with cautery.

R. M. Carter, Green Bay, Wis.: **Chondroma of Bone: Report of Unusual Case.**—A case of multiple enchondromas of an entire lower extremity, together with involvement of the pelvic bones, was presented. Because of persistent and severe pain, as well as the deformity itself, amputation of the entire lower extremity was carried out. On microscopic examination there was no evidence of malignancy. Very good roentgenograms of the lesion were shown.

In discussion, **Kellogg Speed,** Chicago, Ill., described some of the deformities found which caused gargoylism.

James A. Jackson, Madison, Wis.: **Total Gastrectomy for Linitis Plastica, With Case Report.**—In 1933, approximately 88 cases of successful total gastrectomy had been reported, but Dr. Jackson does not believe that in all these cases the pyloric and cardiac sphincters were removed as well as the entire stomach, which is necessary if the operation is to be called total gastrectomy. The case reported was that of a woman, 69 years of age, who had had symptoms referable to the stomach for five months. On roentgenologic examination of the stomach, a diagnosis of linitis plastica was made, which was confirmed by operative findings and microscopic examination. Total gastrectomy and a posterior Polya esophagojejunostomy (isoperistaltic) were performed, the Dixon right-angled colon clamp being used.

In discussion, **Verne Hunt,** Los Angeles, Calif., reported two cases of total gastrectomy; one of the patients lived. **C. A. Roeder,** Omaha, Neb., stated that he had looked up the literature and found that 44 of the 88 patients whose cases were reported survived.

Angus L. Cameron, Minot, N. Dak.: **Sarcoma of the Stomach.**—Two cases of sarcoma of the stomach of a relatively low grade of malignancy which were found among 135 instances of gastric malignancy were reported. Dr. Cameron stated that the degree of malignancy of spindle-cell sarcoma was low. The literature for the past ten years was reviewed.

In discussion, **Verne Hunt,** Los Angeles, Calif., stated that he had had two patients, a boy aged 3 years and a girl 8 months old, who suffered from lymphosarcoma for which he had performed partial gastrectomy. The boy is 11 years old now and quite well. The case of another patient, a physician, was presented who had derived an excellent result from roentgen therapy alone.

S. R. Maxeiner, Minneapolis, Minn.: **The Present Surgical Management of Esophageal Diverticula With Presentation of a New (?) Method.**—An operation was described by means of which the base of the diverticulum is freed up and a curved forceps is applied, after which the diverticulum is cut off with cautery and a cuff is sewed over the clamp. The clamp is left on until it sloughs off; this usually requires about six days. A case was reported in which this method of treatment had been used successfully and several experimental procedures of

a like nature which had been carried out on dogs were described. This method was advocated because it can be performed in one stage and there is little chance of infection.

In discussion, **R. W. McNealy,** Chicago, Ill., stated that he felt all diverticula of the esophagus could not be treated in this manner.

C. W. Mayo, Rochester, Minn.: **Malignant Lesions of the Cecum and Right Half of the Colon.**—An analysis has been made, both general and specific, of a series of 885 consecutive cases with special reference to the mortality after various types of operation for resection of the right half of the colon, both of one-stage and two-stage varieties. The advantages and disadvantages of each were discussed. An analysis also was made of the factors involved in prognosis, both immediate and distant, in malignancy of the right half of the colon.

J. W. Duncan, Omaha, Neb.: **Hernia of the Large Intestine.**—Six cases of true sliding hernia of the large intestine were reported. The diagnosis usually is not made until the time of operation, which makes the danger of the injection therapy obvious. Dr. Duncan advised early surgical intervention in nonreducible hernias and has found it best not to retroperitonealize the gut routinely when it is freed up. The pathologic anatomy of this condition was reviewed.

A. N. Collins, Duluth, Minn.: **Fecal Fistula Following Appendicitis.**—Study of eighteen cases of fecal fistula in Duluth hospitals was reported; in all the condition was serious and in 61 per cent gangrene occurred. Dr. Collins advocated inversion of the stump.

The discussors of this paper emphasized the necessity of being on the lookout for tuberculosis, actinomycosis, and so forth.

V. C. David, Chicago, Ill.: **Presidential Address.**—The rather wide prevalence of fee splitting was discussed. In connection with the Wagner National Health Bill, Dr. David is against state public health officials being in power because of the danger of too much politics. He advocated a cabinet officer to be concerned with health and veterans. He also advocated a nonpolitical, nonprofit project for the indigent and for the low-income group (0 to $1,500 or $2,000). He feels that others are well cared for now. It is his opinion that laymen should be represented on hospital boards.

C. J. Hunt, Kansas City, Mo.: **Diagnosis and Surgical Removal of Substernal and Intrathoracic Goiters.**—The author stressed the necessity for adequate roentgenologic investigation to determine the position and depth of the lesion and the necessity for lateral as well as anteroposterior roentgenograms to determine the relative position of the trachea. He uses local block and infiltration anesthesia and intratracheal anesthesia whenever advisable, with a mixture of helium and oxygen. He advised the use of a large, low-collar incision; ligation of the superior thyroid arteries first; clamping of blood vessels from above downward; and care not to produce a vacuum when elevating the gland, as the blood vessels are thin and friable. He uses a posterior approach.

In discussion, **C. A. Nafe,** Indianapolis, Ind., stated that the roentgenograms do not always give positive evidence of goiter, even when one is present. He advised checking the vocal cords before operation.

K. A. Meyer, Chicago, Ill.: **Internal Drainage of Pancreatic Cyst.**—Internal drainage of unresectable pancreatic cysts has been advocated in preference to external drainage in order to avoid prolonged draining of abdominal wounds and not infrequent secondary infection of the cysts. He advocated freeing the gall bladder from its bed and then anastomosing it to the pancreatic cyst. The

cyst is found to have completely disappeared at a second operation. Dr. Meyer feels that the contents of the cyst are absorbed by the mucosa of the gall bladder because equally good results were obtained whether or not the cystic duct was ligated.

In discussion, **J. D. Bisgard,** Omaha, Neb., stated that he felt that the cystic duct never should be closed because the gall bladder might fibrose from the action of the pancreatic juice and then would be unable to absorb the contents of the cyst.

Cuthbert Powell, Denver, Colo.: **Granulosa-Cell Tumor of the Ovary.**—Granulosa-cell tumors make up approximately 12 per cent of all ovarian tumors and are almost always found in the ovary. Dockerty's recent study was quoted. Complete removal of the tumors rarely is followed by recurrence. One patient gave a history of seven miscarriages.

O. F. Lamson, Seattle, Wash.: **Multiple Primary Carcinoma.**—At all operations for carcinoma, a careful search should be made for multiple lesions because the fact that a malignant growth is present indicates that the patient is susceptible to cancer. The literature was reviewed. One of Dr. Lamson's patients had malignant polyp of the colon and later carcinoma of the breast was found. Another patient had papillary adenocarcinoma of the ovary, as well as carcinoma of the cecum. The latter had obstructed the appendix which, in turn, had become inflamed. A Mikulicz type of resection and an ileostomy were performed.

REPORT OF THE TWENTY-FIFTH ANNUAL MEETING OF THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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(From the Department of Radiology, University of Minnesota)

PAPERS of interest to the surgeon presented at the twenty-fifth annual meeting of the Radiological Society of North America held in Atlanta, Ga., Dec. 11 to 15, 1939, were as follows:

Milton Friedman, New York, N. Y., described a new applicator for use in radium treatment of carcinoma of the corpus uteri. This applicator, termed by the author, the hysterostat, permits fixation of the radium capsules inside the uterine cavity in such a manner that in practically any size or shape of cavity a fairly even distribution of radium emanation is effected. A hinged capsule holder which is attached to a metallic rod can be inserted through the cervical canal in a position parallel to the rod, and later, when in the cavity, rotated to a position at right angles to the rod. Doses ranging from 4,000 to 7,700 mg. hr. of radium have been applied. Films of the pelvis made after radium insertion to show the distribution of radiation intensity indicate an improvement over the conventional methods of application. It was shown that in cases wherein the uterine cavity was deformed by tumor masses an effective distribution of radiation intensity to all parts of the cavity could be obtained. In seven of eight cases having had hysterectomies following this type of radium application, histologic examination revealed no evidence of viable carcinoma cells.

Lowell S. Goin and **Eugene F. Hoffman,** Los Angeles, Calif., described a new approach to treatment of certain types of carcinoma of the urinary bladder. Direct

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contact therapy is employed after marsupialization of the bladder. A midline cystotomy is employed, and, after closing of the space of Retzius, a drainage tube is left in place until the ninth or tenth postoperative day. A low voltage therapy tube, covered by sterile rubber stockinet, is used; the distance from the target to the tumor surface is only 22 mm. so that a very high r. output is obtained. The tumor is treated on alternate days, and doses as high as 30,000 r. over a period of twenty-seven days have been given. No formal presentation of results obtained was given, but favorable results are indicated from observation of the cases treated.

Edmund P. Halley, Decatur, Ill., reported on his experiences with preoperative irradiation of breast carcinoma. Microscopic study of the treated carcinomatous breasts indicated two types of damage to carcinoma cells: (1) primary necrosis of the more sensitive cells, and (2) mutational changes evidenced by giant-cell-like areas which undergo calcification. Tumor-bed changes are negligible when protracted irradiation is used. The author does not favor a short preoperative course since the maximal damaging effect on cells is not obtained in this manner. Therefore, the preoperative irradiation is carried to a full second-degree erythema reaction in a period of about four weeks, treating the breast and gland-bearing areas. Surgical removal is effected as soon as desquamation is complete, and in most of the reported cases the operation was performed within two to four weeks following completion of irradiation. Surgery should not be delayed beyond four weeks, after which time cancer cell regrowth is probable.

L. W. Paul, Madison, Wis., presented four cases of solitary or plasma cell myeloma of bone. This solitary, medullary, destructive lesion of bone must be differentiated from giant-cell tumor, since the resemblance is often striking. At times, the tumor may also simulate localized cystic disease of bone. Surgical removal of this type of lesion is very rarely justifiable, since recurrences take place, and the disease often develops into the better known generalized type, multiple myeloma. In small lesions of an extremity curettage followed by roentgen radiation therapy is advised. Lesions involving the spine or pelvis are best treated by roentgen irradiation alone.

W. Edward Chamberlain, Philadelphia, Pa., pointed out the importance of recognition of a developmental anomaly of the occipital bone and upper cervical vertebrae, termed platybasia or basilar impression. In this condition a stenosis of the foramen magnum is present, together with a cephalic bulging of the clivus and neighboring structures into the posterior fossa of the cranium. Pressure on the cord produces a train of symptoms very similar to those of syringomyelia, disseminated sclerosis, or various types of spastic paralysis. A considerable possibility of relief is offered these patients by surgical procedures correcting the cord compression. If all cases diagnosed syringomyelia are subjected to roentgen examination of the skull and cervical spine, it is quite probable that more cases of platybasia will be encountered.

Maurice F. Dwyer, John M. Blackford, and **William S. Cole,** Seattle, Wash., reviewed the clinical and roentgenologic aspects of 1,000 consecutive cases of peptic ulcer. The diagnosis in each case had been confirmed by careful roentgenologic and clinical studies. Especial attention was directed toward perforation and hemorrhage.

The highest incidence of perforation of both duodenal and gastric ulcers was in the age period of 30 to 40 years. Ninety per cent of duodenal ulcers perforated the anterior duodenal wall. In 82 cases of perforation 55 occurred during a quiescent period, while 27 cases perforated during a period of active symptoms. In the 82 perforated cases 4 had associated massive hemorrhage.

Duodenal ulcer was the most frequent cause of hemorrhage. Although massive hemorrhage occurs with equal frequency before and after 45 years of age, 96 per cent of the deaths from massive hemorrhage occurred in patients over 45 years of age. Since only 4 per cent of patients under 45 years die from massive hemorrhage, the authors pointed out that surgical intervention in young people is rarely justified. On the other hand, in patients over 45 years of age prompt surgical procedures may save many lives.

An average fourteen years' follow-up of 64 cases of duodenal ulcer receiving surgical treatment alone indicated that 86 per cent had obtained satisfactory relief and in 14 per cent the response was unsatisfactory; whereas, in 77 cases receiving medical treatment alone 65 per cent obtained satisfactory relief, and in 35 per cent the relief was unsatisfactory.

In the entire series the same clinicians and roentgenologist attended these patients.

A Symposium on Acute Intestinal Obstruction was participated in by a number of essayists. The experimental and clinical observations which bear upon the diagnosis and management of acute intestinal obstruction were detailed by **Owen H. Wangensteen,** Minneapolis, Minn. He emphasized the necessity for intimate correlation of the roentgen and clinical findings in order to arrive at a rational therapeutic procedure in all acute abdominal states. When this is done, it is possible to determine definitely whether the bowel is obstructed, whether the obstruction is simple or strangulating, complete or incomplete, and approximately in what portion of the intestinal tract it is located. The exact location is frequently impossible to determine and the manner in which the bowel is obstructed is also unrevealed without operation. **James E. Lofstrom,** Detroit, Mich., described the procedure of intubation with the Miller-Abbott tube and the value of this procedure in the diagnosis and localization of obstructive processes in the small intestine. Numerous cases of inflammatory, tumorous, and gallstone obstructions were demonstrated to illustrate the utility of intubation, with decompression, followed by roentgen examination, as a means of delineation of the obstruction. Roentgen studies of the small intestine with the Miller-Abbott tube were described by **Ross Golden,** New York, N. Y. He emphasized the necessity for deflation of the stomach before attempting to pass the tube through the pylorus and the importance of patience and exacting technique in passing the tube to the point of obstruction. After the intestine has been deflated, a small amount of barium sulfate suspension is injected through the tube, making it possible to delineate clearly the exact point and the exact nature of the obstructive process. He demonstrated a number of cases in which the differentiation of mechanical from paralytic ileus was made. The changes in the bowel occasioned by adhesive bands were described.

Leo G. Rigler and **Oscar Lipschultz,** Minneapolis, Minn., discussed **Roentgen Observations on Acute Obstruction of the Colon,** emphasizing especially the value of abdominal films, without contrast, in determining the presence, location, and nature of an obstructive process in the large bowel. The diagnostic criteria which permit a definite diagnosis of acute volvulus of the sigmoid colon were detailed. The authors also presented a new sign of acute perforation of the colon following obstruction; namely, the observation of the outer as well as the inner wall of the bowel in roentgenograms of the abdomen made with the patient supine.

Roentgen Ray Studies on Some Individuals Suffering From Low Back Pain was discussed by **Joseph Bell,** Louisville, Ky. He described a large number of cases in which multiple lesions of the spinal canal were present. In some

instances a herniation of the intervertebral disk low in the lumbar spine was accompanied by another herniation, a complete block from a fracture of the vertebra or a tumor in the thoracic spine or in another portion of the lumbar spine. The importance of complete study of the spine after injection of iodized oil was brought out. **The Use of Thorium Dioxide Sol in Myelography** was presented by **B. H. Nichols**, Cleveland, Ohio. In a series of cases no serious ill effects were observed when the contrast medium was removed from the spinal canal by forced spinal fluid drainage. The colloidal thorium dioxide has advantages over the more viscous oily preparations in that it is more miscible with spinal fluid and can be drawn off readily by forced drainage. **L. H. Garland** and **E. J. Morrissey**, San Francisco, Calif., presented a study of **Intracranial Collections of Opaque Oils Following Lumbar Myelography.** They found large collections of iodized oil in the cranial cavity in two-thirds of 35 cases in which myelography had been done a number of years previously. In none of these cases could any evidence be obtained to indicate any harmful effects of the iodized oil.

Wendell Scott, St. Louis, Mo., emphasized the importance of the oblique position in making roentgen examinations of the spine. In this manner he was able to demonstrate fractures of the articular processes and dislocations of the apophyseal joints which had been previously overlooked.

A Symposium on Nuclear Physics in the Service of Medicine arranged by **Robert R. Newell,** San Francisco, Calif., and participated in by **M. A. Tuve,** Washington, D. C.; **William F. Bale,** Rochester, N. Y.; **John H. Lawrence,** Berkeley, Calif.; and **Robert S. Stone,** San Francisco, Calif., concerned itself with the theoretical and practical considerations of the utilization of artificially radioactive elements, both for investigation of biological reactions and for the treatment of disease. Certain radioactive metals are extremely effective, even when taken internally in the treatment of leukemia. Stone and Lawrence described the skin and mucosal reactions of patients exposed to fast neutrons, produced by the cyclotron, and the response of tumors to this type of irradiation. While still experimental, there appear to be good possibilities in this form of therapy.

Book Reviews

Cancer: Its Diagnosis and Treatment. By Max Cutler, M.D., and Franz Buschke, M.D. Cloth. Pp. 757, with 346 illustrations. Philadelphia, 1938, W. B. Saunders Company. $10.

This monograph on malignancy written by two radiologists is essentially sound. The pathologic bases of their discussions are good and radiologists, as well as surgeons, in the main, would agree with their conclusions. The text is well annotated with references to pathologic, radiologic, and surgical sources of known merit.

The statement of the authors that attempts at surgical treatment of carcinoma of the esophagus have been uniformly unsuccessful is not in accord with the experience of thoracic surgeons of the last few years. The authors deny any established causative relationship between gastric ulcer and cancer; a thesis that appears to have strong pathologic support. The authors believe that chronic cystic disease is in some of its manifestations a precancerous lesion and advocate mastectomy with more assurance than more conservative surgeons would agree is justifiable.

This treatise on cancer should prove a handy reference manual in any practitioner's library. It is well written and profusely illustrated.

Classic Descriptions of Disease. With Bibliographical Sketches of the Author. Ed. 2. By Ralph H. Major, M.D. Cloth. Pp. 727, with 137 illustrations. Springfield, Ill., 1939, Charles C. Thomas, Publisher.

The author's capacity to garner informative data in a critical way and to assimilate it in a fascinating manner is demonstrated again throughout this interesting volume. The original descriptions of disease entities, which have since become generally familiar, have been made available to a wide audience in this monograph. In addition, the short biographical sketches are very well done and in them a variety of most interesting stories are brought to light: of how Jenner was refused permission by the Royal Society to communicate his observations on smallpox inoculations, with this admonition that "he ought not to risk his reputation by presenting to the learned body anything which appeared so much at variance with established knowledge, and withal so incredible"; of how Cruveilhier was filled with such a distaste for medicine upon witnessing autopsies that he fled from the medical school and entered a Catholic seminary and how his domineering father compelled his re-entry into medicine; and a number of other fascinating stories from the lives of those who have contributed richly to medicine.

As one reads this volume, one cannot help but wonder how a number of diseases, such as those described by Addison, Bright, and Raynaud and others, came to have the names of the authors attached and how in equally as important contributions in other instances this baptism of the disease or discovery does not follow.

Under the caption of diseases of the blood, wherein the writer lists the contributions of Combe, Addison, and Minot to pernicious anemia, the reviewer was distressed to note the omission of Whipple's name, without whose work the discovery of Minot might well not yet have been. Similarly in the chapter on the

infectious diseases, one misses the names of men like Koch, V. Behring, Wassermann, and others. The author's apology for such omission in the preface to the first edition scarcely justifies his decision. After all, in a monograph of this sort one should justifiably expect to find something of the most significant contributions to medicine. There is no word of Pasteur, nor of Lister, nor of Koch, nor of Roentgen. It is obviously a large and important labor to resurrect these fascinating classic descriptions of earlier periods, yet the omission of the most significant of classic contributions to medicine of all time is somewhat startling, if not poor emphasis, in so unique a monograph.

Failure of the Circulation. Ed. 2. By Tinsley R. Harrison, M.D. Cloth. Pp. 502, with 61 illustrations and 22 tables. Baltimore, 1939, Williams and Wilkins Company. $4.50.

The subject of the failure of the circulation the author has considered from two standpoints: (1) forward failure, and (2) backward failure, the latter being synonymous with congestive heart failure. The latter major division, to which the book is largely given over, is concerned largely with the mechanism and causes of dyspnea and embodies the well-known experiments of the author concerning the influence of reflexes in the stimulation of respiration. The work of Landis on edema formation and the effects of edema, in turn, upon the circulation are well reviewed. The forward failure of the circulation includes an intelligent discussion on surgical shock, reviewing, in part, the work of Blalock and his colleagues.

This monograph can be recommended enthusiastically to all who are interested in the mechanism and the physiology of the circulation. For internists, it presents the added feature of discussing the therapy of backward failure of the circulation in an unusually enlightened manner.

Maternal Care and Some Complications. Edited by F. L. Adair, M.D. Cloth. Chicago, 1939, University of Chicago Press. $1.50.

"The purpose of this book is to set forth in simple and concise form some of the basic principles of maternal care and of the management of three major complications." These latter are the pregnancy toxemias, obstetric hemorrhages, and puerperal infection. The book is prepared by eight of the senior obstetricians of this country and has been approved by the American Committee on Maternal Welfare. It is presumably prepared for the general practitioner who lacks time or inclination to consult more detailed sources and for nurses who work in the public health field of obstetrics. It is divided into two portions. The first makes up one-half of the book and is a detailed description of the practical aspects of ante-partum, intrapartum, and post-partum care. The second half is devoted to the three complications listed above.

The first half will serve as a useful guide and should stimulate careful observation and attention to detail. The second half suffers from a necessary brevity. In many features it appears to represent a compromise between the differing views of a number of the authors and there are numerous statements which will not find general acceptance. These are, however, details and the book should be of value in the hands of those for whom it is intended.